East Java Economic Journal Vol. 7 No. 2 (2023): 217-247

ejavec JOURNAL

EAST JAVA ECONOMIC JOURNAL

https://ejavec.id

INTEGRATING FISCAL POLICY MIX AND ENVIRONMENTAL POLICY IN EAST JAVA'S CIRCULAR ECONOMY DEVELOPMENT: A MULTIDIMENSIONAL APPROACH ASSESSING ECONOMIC, SOCIAL, AND LEGAL FACTORS

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ABSTRACT

This study aims to provide a more holistic understanding of how environmental and fiscal policies can complement each other to promote a circular economy in East Java. The method used in this study is panel data regression analysis using secondary data covering the period 2001-2020. Data were collected from government agencies such as the Ministry of Finance, the East Java Central Bureau of Statistics, the Ministry of Environment and Forestry, and the Supreme Audit Agency. The results show that environmental and fiscal policies significantly impact the circular economy in East Java. Environmental regulations, which include central and local government policies, promote the growth of the circular economy. The Regional Original Revenue (PAD) also plays an essential role in influencing the circular economy in the region. The proposed policy recommendations include the design of incentives to encourage the adoption of circular economy principles, the optimal allocation of special environmental and circular economy funds, the adaptation of education and training to the needs of the circular economy, the promotion of research and innovation in the circular economy, and the joint implementation of environmental regulations.

Keywords: *Circular Economy, Environmental Regulation, Fiscal Policy*

ABSTRAK

Penelitian ini bertujuan untuk memberikan pemahaman yang lebih holistik tentang bagaimana kebijakan lingkungan dan fiskal dapat saling melengkapi untuk mendorong ekonomi sirkular di Jawa Timur. Metode yang digunakan dalam penelitian ini adalah analisis regresi data panel dengan menggunakan data sekunder yang mencakup periode 2001-2020. Data diperoleh dari berbagai instansi pemerintah, seperti Kementerian Keuangan, Badan Pusat Statistik Jawa Timur, Kementerian Lingkungan Hidup dan Kehutanan, dan Badan Pemeriksa Keuangan. Hasil penelitian menunjukkan bahwa kebijakan lingkungan dan fiskal memiliki pengaruh signifikan terhadap ekonomi sirkular di Jawa Timur. Peraturan lingkungan yang mencakup kebijakan pemerintah pusat dan daerah mendorong pertumbuhan ekonomi sirkular. Pendapatan Asli Daerah (PAD) juga berperan penting dalam mempengaruhi ekonomi sirkular di daerah. Rekomendasi kebijakan yang diusulkan meliputi desain insentif untuk mendorong adopsi prinsip ekonomi sirkular, alokasi dana khusus lingkungan dan ekonomi sirkular secara optimal, adaptasi pendidikan dan pelatihan sesuai kebutuhan ekonomi sirkular, promosi penelitian dan inovasi dalam ekonomi sirkular, serta implementasi peraturan lingkungan yang kolaboratif.

Kata Kunci: *Circular Economy, Environmental Regulation, Fiscal Policy*

JEL : **E62, K40, O13**

RIWAYAT ARTIKEL

Received:
4 Agustus 2023
Revised:
25 Agustus 2023
Accepted:
16 Septemebr 2023
Online:
29 September 2023

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East Java Economic Journal, p-ISSN: 2597-8780, e-ISSN: 2830-2001, DOI: 10.53572/ejavec.v7i2.110, Open access undera Creative Commons Attribution- 4.0 International Public License (CC - BY 4.0)
published by Kantor Perwakilan Bank Indonesia Provinsi Jawa Timur in Collaboration with Faculty of Economics and Business, Universitas Airlangga

Introduction

A growing global population requires increased resource consumption to support economic activity. This phenomenon has led to widespread industrialization and resource exploitation (Laurance et al., 2014; Nasrollahi et al., 2020; Van Buren et al., 2016). Most industries still adhere to a linear economy, where business practices are based on conventional business models that rely heavily on resource consumption to create value and generate waste (Lüdeke-Freund et al., 2019; Pieroni et al., 2021). Studies by the United Nations and numerous international organizations indicate that the dominance of the brown economy has been a significant factor in economic development over the past four decades. The brown economy is a pattern of unsustainable economic development characterized by excessive resource consumption and a lack of environmental protection (Ferguson, 2015; S. Zhao et al., 2019). In this context, it is essential to recognize that this growth pattern has significantly negatively impacted the environment and quality of life. Therefore, there is an urgent need to move towards a circular economy that integrates sustainability, resource efficiency, and waste reduction into economic activities.

A circular economy is an approach to the achievement of sustainable economic development with a focus on the improvement of social welfare and the restoration of ecosystems through the management of waste and the use of renewable energy. This strategy has three main principles: reduce, recycle, and reuse materials, and use innovation and technology to achieve maximum efficiency in the production process (Korhonen, Nuur, et al., 2018; Yamaka et al., 2022). According to Xiao et al. (2020), waste-to-energy (WTE) technologies are essential to the circular economy, as they can generate renewable energy and support sustainable development. The adoption of a circular economy has a positive impact on economic growth and contributes to environmental sustainability (Castillo-Acobo et al., 2022; Hysa et al., 2020; Ogunmakinde et al., 2022). In this context, it is essential to recognize that the transition to a circular economy will require significant adjustments in business practices and public policies. In the long term, a circular economy can generate additional economic value by creating green jobs, improving resource use efficiency, and reducing greenhouse gas emissions and pollution (Androniceanu et al., 2021; Geng et al., 2012). Therefore, developing and implementing a circular economy should be a priority for policymakers, industry, and society to create a more sustainable and inclusive future.

Considering the potential benefits of the circular economy for achieving sustainable development and improving social welfare, Indonesia needs to take strategic steps to participate in the green economy. One aspect that can be done is to address the existing generation of waste that needs to be managed following the principles of the circular economy. Based on data from the National Waste Management Information System (SIPSN) managed by the Ministry of Environment and Forestry (KLHK), Indonesia produced approximately 19.45 million tonnes of waste in 2022. Central Java has the highest amount of waste, reaching 4.25 million tonnes, or 21.85% of the total national waste production that year. DKI Jakarta Province came second with 3.11 million tonnes of waste or 15.98% of the total national waste. East Java came third with 1.63 million tonnes of waste (8.38%), followed by West Java with 1.11 million tonnes (5.7%) and Riau with 1.05 million tonnes (5.39%). Meanwhile, the province with the lowest waste generation in 2022 is West Papua, with only 18.16 thousand tonnes. In addition to West Papua, North Kalimantan, and West Nusa Tenggara are also included in the provinces with the lowest waste production, producing 20.75 thousand tonnes and 37.44 thousand tonnes, respectively (Ministry of Environment and Forestry, 2022).

The role of environmental regulation in minimizing negative environmental impacts and the depletion of natural resources is an essential aspect of developing a circular economy. For example, Jiang and Mcikibbin found that implementing a pollution levy system in China since 1982 has positively affected reducing pollution (Shang et al., 2022). Many previous studies have confirmed the positive function of environmental regulation in the energy

and environment context, including increasing environmental efficiency, reducing energy consumption, reducing carbon emissions, and controlling SO_2 emissions and smog pollution (Curtis & Lee, 2019; Galloway & Johnson, 2016; Y. Liu et al., 2018; Wang et al., 2019). Effective environmental regulation is crucial in promoting green and sustainable economic growth (Pan et al., 2021; Shao et al., 2020; X. Zhao et al., 2022). In a circular economy, these policies encourage industries to adopt environmentally friendly practices, such as reducing waste, using resources more efficiently, and integrating green technologies into production (Lin et al., 2001; Orange & Cohen, 2010; Wu & Dunn, 1995). In addition, environmental regulatory policies that encourage innovation and the development of sustainable technologies can accelerate the transition to a circular economy (De Jesus & Mendonça, 2018; Di Maio & Rem, 2015). Cooperation among nations in developing comprehensive and effective environmental policies is essential to foster the growth of a circular economy in a global context.

Support for environmental policies or regulations will be necessary to realize a sustainable circular economy (Pan et al., 2021; Shao et al., 2020). Previous studies have shown that government budget support from the expenditure side will accelerate economic growth (Aminah, 2016; Safitri et al., 2021; Sari et al., 2016). However, budgetary support is essential for successfully implementing a circular economy. Fiscal policy, particularly in the context of government spending, plays a crucial role in accelerating the growth of an inclusive and environmentally beneficial circular economy. Fiscal policy spending can include a range of initiatives that support the circular economy, such as investment in green infrastructure, funding for research and development of green technologies, and subsidies to industries that adopt green practices (Khan et al., 2021; Ngan et al., 2019; Rizos et al., 2016; Tang et al., 2022). In addition, the government could invest in education and training programs to increase the capacity of human resources to manage a circular economy (Jabbour et al., 2019; Jawahir & Bradley, 2016). Public spending can help create green jobs, reduce the use of natural resources, and improve energy efficiency and waste management in a circular economy (Caglar & Ulug, 2022; Z. Liu et al., 2022). In addition, government fiscal support can encourage private sector investment in green technologies and innovation (Guo et al., 2018; Owen et al., 2018). This will help create a business climate conducive to the development of a circular economy and the transition to sustainability.

Support for environmental policies or regulations will be necessary to realize a sustainable circular economy. However, budgetary support is essential for successfully implementing a circular economy. Fiscal policy, particularly in the context of government spending, plays a crucial role in accelerating the growth of an inclusive and environmentally beneficial circular economy. Fiscal policy spending can include a range of initiatives that support the circular economy, such as investment in green infrastructure, funding for research and development of green technologies, and subsidies to industries that adopt green practices. In addition, the government could invest in education and training programs to increase the capacity of human resources to manage a circular economy. Numerous studies show that fiscal policy, particularly government spending, positively impacts accelerating economic growth. Public spending can help create green jobs, reduce the use of natural resources, and improve energy efficiency and waste management in a circular economy. In addition, government fiscal support can encourage private sector investment in green technologies and innovation. This will help create a business climate conducive to developing a circular economy and transitioning to sustainability. The analysis will focus on government expenditures, investments in green infrastructure, and incentives and subsidies offered to green industries. This research will provide a more holistic understanding of how environmental and fiscal policies can complement each other to promote a circular economy in East Java by combining these two aspects. Hopefully, the findings of this study will result in policy recommendations for the central and local administrations, as well as the identification of opportunities and obstacles in East Java's implementation of a circular economy. In addition, this research will significantly contribute to developing the literature on circular economy and local and

national environmental and fiscal policies. In this study, the structure is organised as follows: The second section outlines an in-depth literature review on the circular economy; the third section describes the data and methodology used; the fourth section presents the results of the empirical analysis; and the fifth section draws conclusions and provides relevant policy recommendations.

Literature Review

Kirchherr et al. (2017) define the circular economy as an economic system that replaces the concept of 'end-of-life' by reducing, reusing, recycling, and recovering materials in production, distribution, and consumption processes. This system operates at micro (products, companies, consumers), meso (eco-industrial parks), and macro (cities, regions, countries, etc.) levels to achieve sustainable development. It seeks to improve environmental quality, economic prosperity, and social equity to benefit present and future generations. This can be achieved by creating new business models and increasing consumer responsibility. The circular economy is based on three fundamental principles: reducing waste and pollution, maximizing the value of products and materials, and regenerating natural systems (Knäble et al., 2022; MacArthur, 2017). Respecting these three principles results in a circular economic value hierarchy consisting of (1) renewable resources, (2) reuse and sharing, (3) repair and sharing, and (4) recycling.

The use of renewable resources aligns with all the principles of a circular economy (Korhonen, Honkasalo, et al., 2018; Mutezo & Mulopo, 2021). The transition to renewable energy is crucial to establishing a circular economy. Reuse and sharing are also consistent with all three principles of a circular economy, keeping limited resources in the economic cycle and preserving the product's overall value. This reduces the demand for new resources and increases resource efficiency on a global scale (MacArthur, 2017). Repair and remanufacturing also aim to maintain the highest possible value of the product, even if this requires more effort and resources. Consequently, maintenance and remanufacturing occupy the third position in the hierarchy. Furthermore, reuse and refurbishment demonstrate a more substantial commitment to circularity than secondary raw materials and recycling. Regarding resource and energy use, recycling is less efficient than reuse and refurbishment (Llorente-González & Vence, 2020; Moraga et al., 2022). According to Matsumoto et al. (2016), remanufacturing and refurbishment processes are superior to material recycling because they retain more of the original energy and materials in the economic stream. Therefore, the circular economy should prioritize resource and energy management strategies that are more efficient.

GRDP for Water Supply, Waste Management, Waste, and Recycling in East Java

Gross domestic product (GDP) reflects a nation's national income, which can be used to measure its economic growth (Kira, 2013). GDP quantifies the value of goods and services produced by a nation during a given period, using both domestic and foreign factors of production (Dama, 2016). GDP can be expressed in market, current, or fixed prices (Adnan, 2013; Kosuma, 2016; Romhadhoni et al., 2019). Gross Regional Domestic Product (GRDP) is the total value of goods and services produced in a region over a given period, usually one year. The economic progress of a region is indicated by a GRDP value that indicates rapid economic growth (Menajang, 2019; Putro & Setiawan, 2013; Soebagiyo, 2007). The Central Bureau of Statistics (BPS) defines GRDP as the total value added generated by all regional economic units. GRDP includes the total value of final products and services produced by all regional economic units (Dama, 2016). GRDP can be calculated at current or constant prices, which characterize the value added of products and services in the reference year.

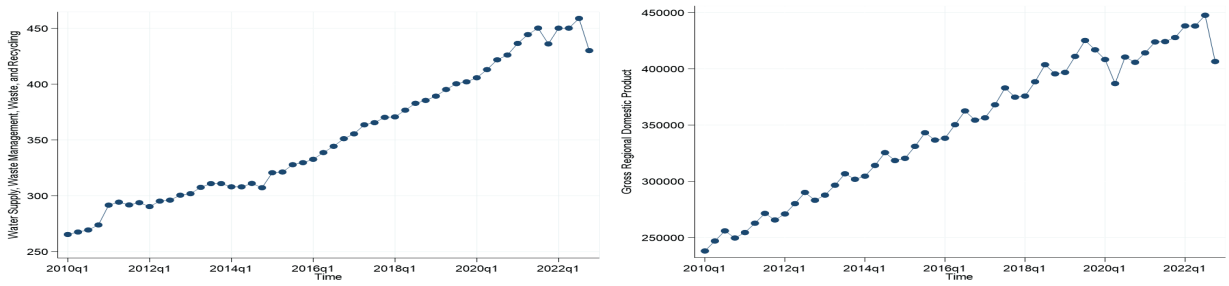

Figure 1: Trends in East Java Gross Regional Domestic Product and Gross Regional Domestic Product for Water Supply, Waste Management, Waste, and Recycling

Source: Processed by the author from East Java Central Bureau of Statistics (2022)

The water supply, waste management, and recycling sector is one of the economic sectors that contribute to East Java's GRDP, although to a lesser extent than other sectors. This sector's contribution to East Java's GRDP from 2018-2022 was approximately 0.09 percent. The growth rate of this sector fluctuated during the same period. The growth of this sector reached 4.18 percent in 2018 and continued to increase until it reached 5.67 percent in 2021. In 2022, however, growth fell to 2.26 percent (East Java Central Bureau of Statistics, 2023). This industry includes economic activities related to the management of various forms of waste that have the potential to pollute the environment. This waste management process produces outputs discarded or used as inputs in other production processes. Water supply activities also fall into this category as they are often related to or carried out by waste management enterprises. Although the contribution of this sector is relatively modest, the GRDP trend for this industry has been increasing since 2010. This aligns with the general upward trend of East Java's GRDP, as shown in Figure 1.

Fiscal Policy and Sustainable Economic Growth

In the context of government expenditure and its impact on economic development, different results from different studies illustrate differences in the implementation and methodology of fiscal policy. Some studies show a positive relationship between government expenditure and economic development, while others show the opposite. For instance, Onifade et al. (2020) found that recurrent government expenditure had a significant negative impact on economic growth, while the impact of public capital expenditure was insignificant. Usman (2011) found that public expenditure in Nigeria has no effect on economic development, but a long-run relationship exists between public expenditure and economic growth. According to Chu et al. (2020), a one percentage point change in the ratio of government spending from less productive to more productive sectors increases real GDP per capita growth by 0.05 percentage points in high-income countries. In a circular economy, fiscal policy can include initiatives such as investment in green infrastructure, funds for green technology research and development, and support for industries that adopt green practices (Khan et al., 2021; Ngan et al., 2019; Rizos et al., 2016; Tang et al., 2022). In addition, the government could invest in education and training programs to increase the capacity of human resources to manage a circular economy (Jabbour et al., 2019; Jawahir & Bradley, 2016). Zhang et al. (2021) found that public spending on green energy technology R&D and human resources (education) can accelerate the growth of the green economy. Public spending in a circular economy can help create green jobs, conserve natural resources, and improve energy efficiency and waste management. Consider the role of fiscal policy in promoting a circular economy and achieving sustainable economic growth.

Environmental Regulation and Circular Economy

The importance of environmental regulation in curbing the growth of environmental damage should be observed in line with the crucial role of government in addressing environmental issues. Extensive research has been conducted on the relationship between environmental regulation and economic impacts, including efficiency, behaviour change and innovation (Du et al., 2021; Lăzăroiu et al., 2020; Luo et al., 2021; Yusliza et al., 2020). Companies may initially feel burdened by the costs of complying with regulations, but this will stimulate innovation and efficiency creation in the long run (Blind, 2012; Pelkmans & Renda, 2014; Wallace, 1995). For example, Curtis & Lee (2019) examined the effectiveness of NOx policies in reducing NOx emissions from regulated power facilities. The results showed a reduction in NOx emissions of between 28 and 36%, demonstrating the effectiveness of regulation. Shang et al. (2022) discovered that environmental regulation has a linear function in promoting circular economy performance through the *'catch-up effect.'* Galloway & Johnson (2016) found that adapting to environmental regulations brings additional benefits to companies. According to this study, companies implementing environmental regulations will share this knowledge with other organizational units. As a result, environmental policies will encourage industries to adopt environmentally friendly practices, such as reducing waste, using resources more efficiently, and incorporating green technology into production. In the context of a circular economy, environmental regulation is a crucial pillar for the transition to a more sustainable business model. The above research demonstrates the importance of environmental regulation in driving industry-wide behaviour change and innovation. To achieve the goal of an inclusive and sustainable circular economy, government, business and society must work together to develop effective regulations that facilitate its implementation.

Research Methodology

Theoritical Background: Keynes' Classical Theory and Wagner's Law

The classical theory of Keynes suggests that government intervention in the economy promotes optimal economic growth and explains the role of government in economic growth (Abu-Bader & Abu-Qarn, 2003). According this theory, the government should regulate economic activity through monetary and fiscal policies (interest rates and money supply). According to Keynesian theory, national income growth is a function of consumer spending, government spending, investment, and net exports. Keynes argued that an increase in consumer demand, government spending, investment, exports, and imports is necessary for economic development as measured by an increase in national income (Azwar, 2016). On the other hand, economist Adolf Wagner argued that government spending and government activity tend to increase over time. Examining the ratio of government spending to gross domestic product in Europe, the United States, and Japan during the 19th century, Wagner found that government activity in the economy was increasing. Wagner called this phenomenon the law of expanding government activity. Wagner claimed that economic growth influences government spending (Abdullah & Maamor, 2010; Azwar, 2016; Natarajan et al., 2022), contrary to Keynes' theory that government spending influences economic development. Specifically, as an economy's per capita income increases, the relative amount of government spending will also increase. Wagner's theory is based on the organic theory of the state. In this theory, the government is seen as an autonomous individual, free to act independently of the rest of society. Wagner offers an alternative view of the relationship between government spending and economic growth, thereby contributing to developing effective circular economy policies and strategies. Combining the perspectives of Keynes and Wagner in the analysis of economic growth and the function of government will provide a more thorough understanding of how government spending and economic growth interact in the context of a circular economy. Wagner's Law can be formulated as follows (Azwar, 2016):

$$\frac{GpC_t}{YpC_t} > \frac{GpC_{t-1}}{YpC_{t-1}} > \frac{GpC_{t-2}}{YpC_{t-2}} > \ldots > \frac{GpC_{t-n}}{YpC_{t-n}}$$

Description:

GpC = Government expenditure per-capita

YpC = Product or national income per-capita

t = Time index

Research Framework

This study seeks to examine the impact of environmental regulations and fiscal policy on the circular economy, including applying sustainable resource management concepts. In this context, the fiscal policies analyzed include central and local government expenditures and revenues. In this study, local government expenditure is defined as environmental expenditure, which includes spending on environmental protection and preservation, whereas central government expenditure is defined as special allocation funds allocated for environmental programs. General Allocation Fund and Local Original Revenue represent local government funding sources and are the control variables used in this research framework. The environmental policies analyzed in this study include central and local government regulations that support the circular economy. An example of a relevant central government policy is the Minister of the Interior's Regulation No. 33/2010 on Waste Management Guidelines, which directs local governments to develop waste reduction and management plans as outlined in strategic plans and annual work plans. On the other hand, local government policies include regent, mayor, governor, and regional regulations, which form the basis for implementing waste management at the local government level. These policies reflect the local government's efforts in waste management to achieve sustainable development.

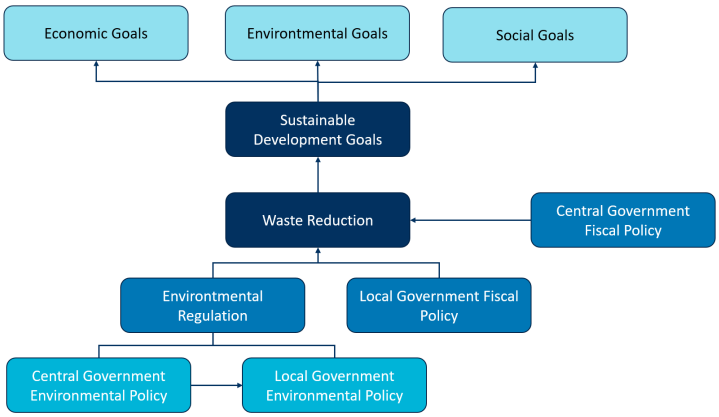

Figure 2: Research Framework

Source: Processed by the author

Sustainable development's economic, social, and environmental objectives are interrelated and influence each other. In waste management, economic objectives include cost reduction, resource efficiency, and job creation through technological innovation and environmentally conscious enterprises. Social objectives are to improve people's well-being and quality of life and to provide a healthy and safe environment for present and future generations. Meanwhile, environmental goals include reducing greenhouse gas emissions, preserving biodiversity, and minimizing pollution. By combining fiscal policies and environmental regulations analyses, this research is expected to provide in-depth insights into how this combination of policies can influence the uptake and success of the circular economy at the local government level. In addition, the findings of this study will serve as a basis for more effective decision-making by policymakers at both central and local government levels to drive the transition toward a circular economy. This research will examine the interaction

between fiscal policy and environmental regulation and how this combination affects the development of a sustainable circular economy, creating economic, social, and environmental benefits. The results of this research are expected to assist the government in identifying the challenges and opportunities in integrating fiscal policy and environmental regulation to promote a circular economy. Furthermore, this research will provide recommendations on how the government can optimize fiscal policies and environmental regulations to create an enabling environment for the growth of the circular economy.

Data Collection and Variables

This study uses secondary data in the form of panel data for econometric estimation. Panel data is a combination of time series and cross-sectional data. Time series data with annual data for the period 2001-2020 is used to examine the relationship between fiscal policy, environmental legislation and circular economy in East Java. Meanwhile, the cross-sectional data refers to the number of districts/cities and provinces in East Java. Data sources were obtained from various government agencies, including the Ministry of Finance (accessible via https://djpk.kemenkeu.go.id/), the East Java Central Bureau of Statistics (accessible via https://jatim.bps.go.id/), the Ministry of Environment and Forestry (accessible via https://sipsn.menlhk.go.id/), and the Supreme Audit Agency (https://peraturan.bpk.go.id/). Through this data collection, the research included a total of 780 observations, which were then analysed to gain an in-depth understanding of the factors influencing the circular economy in the region.

Table 1: Variable Operationalisation

Variable	Operationalization	Source	Literature Source
Generation of waste per GRDP, GWP-GRDP	$\frac{Generation\ of\ Waste}{Gross\ Regional\ Domestic\ Product}$	Ministry of Environment and Forestry and East Java Central Bureau of Statistics	(Jermsittiparsert et al., 2020; Yanrong et al., 2011)
GRDP of the Circular Economy Growth (Rupiah), CEGRDP	Natural logarithm of GRDP of Water Supply, Waste Management, Waste and Recycling Business Sector	East Java Central Bureau of Statistics	(Ozturk & Bilgili, 2015; Purwanti, 2020)
GRDP Growth of the Circular Economy (Percentage), RATE-CEGRDP	GRDP Growth of Water Supply, Waste Management, Waste and Recycling Business Sector	East Java Central Bureau of Statistics	(Bhargava et al., 2001; Putra, 2021)
Existence of Regional Legislation for the Circular Economy, PERDA	Using a dummy variable where a value of 0 indicates a year in which there was no legislation in the field of circular economy (waste management) and a value of 1 indicates the opposite.	Database of regulations of the Supreme Audit Institution of the Republic of Indonesia	(Haidar, 2012)
Existence of Central Government Regulation for Circular Economy Regulation in the Region, PEMENDAGRI	A dummy variable is used, where the value of 0 stands for the year in which no regulation was adopted, while the value of 1 stands for the opposite.	Database of regulations of the Supreme Audit Institution of the Republic of Indonesia	(Haidar, 2012)
Government expenditure on environment, ENVEXP	$\frac{Government\ \exp enditure\ on\ Environment}{Total\ government\ \exp enditure}$	Directorate General of Fiscal Balance, Ministry of Finance of the Republic of Indonesia	(Daling, 2013; Soleh, 2015)
Special allocation fund for environment, SPAENV	$\frac{Special\ allocation\ fund\ for\ environment}{Total\ government\ \exp enditure}$	Directorate General of Fiscal Balance, Ministry of Finance of the Republic of Indonesia	(Daling, 2013; Soleh, 2015)

Variable	Operationalization	Source	Literature Source
Waste generation (kg/year), GENWAS	Natural logarithm of waste generation per year	Ministry of Environment and Forestry	(Chalak et al., 2016)
Life expectancy (year), LE	Life expectancy	East Java Central Bureau of Statistics	(Colin et al., 2017; Jermsittiparsert et al., 2020)
Human Development Index, HDI	Human development index	East Java Central Bureau of Statistics	(Ginting, 2020; Muda et al., 2019)
General Allocation Fund (Rupiah), DAU	$\frac{Special\ allocation\ fund}{Total\ government\ \exp enditure}$	Directorate General of Fiscal Balance, Ministry of Finance of the Republic of Indonesia	(Daling, 2013; Soleh, 2015)
Regional Original Revenue (Rupiah), PAD	$\frac{Regional\ original\ revenue}{Total\ government\ \exp enditure}$	Directorate General of Fiscal Balance, Ministry of Finance of the Republic of Indonesia	(Daling, 2013; Soleh, 2015)
Total Area (km^2), AREA	Natural logarithm of total area in a region (cities, districts, and provinces)	East Java Central Bureau of Statistics	(Hartono et al., 2014; Larassati, 2012; Maria et al., 2019)
Total Population (people), POP	Natural logarithm of total population in a region (cities, districts, and provinces)	East Java Central Bureau of Statistics	(Chen et al., 2020)

The author uses content analysis in the Supreme Audit Agency's regulatory database to identify laws and regulations at the local government level that regulate circular economy management (in this case, waste management). The laws and regulations include Regional Regulations, Regent Regulations, Mayor Regulations, and Governor Regulations.

Econometric model

This analysis uses panel data regression, a combination of time series and cross-sectional data. Unlike cross-sectional data, which describe observations from multiple units at a single point in time, time series data include one or more variables observed in a single observation unit over some time. This study uses data from all East Java districts, cities, and provinces from 2001 to 2020. Three static models can be used in panel data analysis: common effect model (CEM), fixed effect model (FEM), and random effect model (REM). These models allow researchers to understand the relationship between the variables studied in a broader spatial and temporal context. The following is an econometric model to explain the effect of environmental policy and fiscal policy mix on circular economic growth in East Java.

1. Environmental Regulation and Environmental Goals

$$GENWAS_{it} = \beta_0 + \beta_1 PERDA_{it} + \beta_2 PERMENDAGRI_{it} + \beta_3 DAU_{it} + \beta_4 PAD_{it} + \beta_5 AREA_{it} + \beta_6 POP_{it} + \varepsilon$$

2. Environmental Regulation and the Circular Economy (Economic Goals)

$$CEGRDP_{it} = \beta_0 + \beta_1 PERDA_{it} + \beta_2 PERMENDAGRI_{it} + \beta_3 GENWAS_{it} + \beta_4 AREA_{it} + \beta_5 POP_{it} + \varepsilon$$

3. Environmental Regulation and Social Goals

$$LE_{it} = \beta_0 + \beta_1 ENVEXP_{it} + \beta_2 PERMENDAGRI_{it} + \beta_3 DAU_{it} + \beta_4 PAD_{it} + \beta_5 AREA_{it} + \beta_6 POP_{it} + \varepsilon$$

4. Fiscal Policy Mix and Environmental Goals

$$GENWAS_{it} = \beta_0 + \beta_1 ENVEXP_{it} + \beta_2 SPAENV_{it} + \beta_3 DAU_{it} + \beta_4 PAD_{it} + \beta_5 AREA_{it} + \beta_6 POP_{it} + \varepsilon$$

5. Fiscal Policy Mix and the Circular Economy (Economic Goals)

$$CEGRDP_{it} = \beta_0 + \beta_1 ENVEXP_{it} + \beta_2 SPAENV_{it} + \beta_3 GENWAS_{it} + \beta_4 AREA_{it} + \beta_5 POP_{it} + \varepsilon$$

6. Fiscal Policy Mix and Social Goals

$$LE_{it} = \beta_0 + \beta_1 ENVEXP_{it} + \beta_2 SPAENV_{it} + \beta_3 DAU_{it} + \beta_4 PAD_{it} + \beta_5 AREA_{it} + \beta_6 POP_{it} + \varepsilon$$

In panel data analysis, the common effect model is a simple technique that integrates time series and cross-sectional data and estimates them using ordinary least squares (OLS). On the other hand, the fixed effect model ignores time and individual dimensions; the intercept and slope of each variable are assumed to be the same for each observation object. According to Basuki & Prawoto (2017), this model implies that differences between individuals are accommodated by differences in intercepts, with each individual being an indeterminate parameter. Meanwhile, the random effects model estimates panel data in which disturbance variables may be related across time and individuals. In this model, differences in the intercepts are accounted for by the error terms for each firm. The ability of the random effects model to deal with heteroskedasticity is referred to as the error component model (ECM). Generalized Least Square (GLS) is the optimal method to fit the random effect model, assuming that the error components are homoscedastic and there is no evidence of the correlation between sections. The following are the econometric models for the three models (Nachrowi & Usman, 2006).

a. Common Effect Model

$$Y_{it} = \alpha + \sum_{j=1}^{K} \beta_j X_{jit} + \varepsilon_{it}; i = 1,2,3,...,N; j = 1.,2,3,...,K; t = 1,2,3,...T$$

b. Fixed Effect Model

$$Y_{it} = \alpha_i + \beta_1 X_{1it} + \beta_2 X_{2it} + \beta_3 X_{3it} + ... + \beta_j X_{jit} + \varepsilon_{it}$$

c. Random Effect Model

$$Y_{it} = \beta_0 + \beta_1 X_{1it} + \beta_2 X_{2it} + \beta_3 X_{3it} + ... + \beta_j X_{jit} + \varepsilon_{it}$$

Three statistical tests are used to select the appropriate model when analyzing panel data: the Chow, Hausman, and Lagrange multiplier tests. The Chow test determines whether the common or fixed effects models are more appropriate. The Hausman test is used to determine whether the fixed effect model or the random effect model is more appropriate. The Lagrange multiplier test is then used to determine whether the random or common effect models are more appropriate for the analysis.

a. Chow Test

The Chow test is used to determine whether the model tends to follow the common effect model or the fixed effect model to determine which approach will be used as the model in this study. The results of this test can be seen from the probability value (Prob) for cross-section F. The hypothesis testing for this test is as follows:

H_0 : Common Effect Model

H_1 : Fixed Effect Model

The selected model is the Common Effect Model (CEM) if the Prob value for cross-section > 0.05. If the Prob value for cross-section is <0.05, then the selected model is the Fixed Effect Model (FEM).

b. Hausman Test

The Hausman test is conducted to determine whether the Random Effect Model or Fixed Effect Model will be selected as the model in this study. Hypothesis testing from the Hausman Test is as follows:

H_0 : Random Effect Model

H_1 : Fixed Effect Model

In testing the best model using the Hausman Test, it can be seen from the probability value (Prob) for Cross-Section random if the Prob value for Cross-Section random > 0.05 then the selected model is the Random Effect Model. If the Prob value for Cross-Section random < 0.05 then the selected model is the Fixed Effect Model.

c. Lagrange Multiplier Test

The Langrange Multiplier test is conducted by comparing the Common Effect Model and the Random Effect Model. Hypothesis testing from the Lagrange Multiplier Test is as follows:

H_0 : Common Effect Model

H_1 : Random Effect Model

This can be seen from the prob > chi^2 value. If the prob > chi^2 value is smaller than the significance level (0.05), then the Random Effect Model is more appropriate. Otherwise, the Common Effect Model is more appropriate.

Result and Discussion

Descriptive Statistics

There are several variables used in this research, including waste production per GRDP (GWPDRDP), circular economy GRDP (CEGRDP), growth of circular economy GRDP (RATECEGRDP), the existence of local regulations for the circular economy (PERDA), the existence of central government regulations for circular economy regulation in the region (PERMENDAGRI), Government Expenditure on Environment (ENVEXP), Special Allocation Fund for Environment (SPAENV), Waste Generation (GENWAS), Life Expectancy (LE), Human Development Index (HDI), General Allocation Fund (DAU), Regional Initial Revenue (PAD), Area (AREA) and Population (POP). The mean, standard deviation, and maximum waste production per GRDP (GWPDRDP) are 1.54781, 3.42747, and 38.64438, respectively. This shows considerable variation in the level of waste production per GDP in different regions. Meanwhile, Circular Economy GRDP (CEGRDP) has a mean of 13.12776 and a standard deviation of 11.94129, illustrating the significant differences in the contribution of the circular economy to GRDP across regions. Circular economy GRDP growth (RATECEGRDP) has a mean of 0.00066, a standard deviation of 0.00094, and a maximum of 0.01488. This reflects the different growth rates of the circular economy in different regions. The existence of regional regulations for the circular economy (PERDA) and the existence of central government regulations for the circular economy in the regions (PERMENDAGRI) have a mean of 0.27821 and 0.55071, and a standard deviation of 0.44840 and 0.49774, indicating differences in the level of adoption of regulations supporting the circular economy at the regional and central levels.

Table 2: Descriptive Statistics

Variable	Obs	Mean	Std. dev.	Min	Max
GWPGRDP	780	1.54781	3.42747	0.00000	38.64438
CEGRDP	780	13.12776	11.94129	0.00000	29.74118
RATECEGRDP	780	0.00066	0.00094	0.00000	0.01488
PERDA	780	0.27821	0.44840	0.00000	1.00000
PERMENDAGRI	780	0.55071	0.49774	0.00000	1.00000
ENVEXP	780	0.01850	0.03166	0.00000	0.34844
SPAENV	780	0.00026	0.00177	0.00000	0.03747
GENWAS	780	5.29994	8.44695	0.00000	20.52004
LE	780	4.23508	0.05037	4.03777	4.30650
HDI	780	0.69282	0.05459	0.49700	0.82220
DAU	780	0.60288	0.21076	0.00061	2.10529
PAD	780	0.13981	0.15603	0.00549	2.79521
AREA	780	6.62902	1.58575	2.80093	10.77478
POP	780	13.65984	0.99522	11.60914	17.50154

Source: Processed by the author with STATA 15

Government Expenditure on Environment (ENVEXP) and Special Allocation Fund for Environment (SPAENV) have a mean of 0.01850 and 0.00026 and a standard deviation of 0.03166 and 0.00177. This indicates variation in government commitment to environmental conservation through budget allocations. Waste Generation (GENWAS) has a mean of 5.29994, a standard deviation of 8.44695, a minimum value of 0.00000, and a maximum value of 20.52004, illustrating variations in the amount of waste generated in different regions. Life Expectancy (LE) has a mean of 4.23508, a standard deviation of 0.05037, a minimum value of 4.03777, and a maximum value of 4.30650, indicating moderate differences in quality of life across regions. The Human Development Index (HDI) has a mean of 0.69282, a standard deviation of 0.05459, a minimum value of 0.49700, and a maximum value of 0.82220, illustrating differences in the level of human development across regions. The General Allocation Fund (DAU) has a mean of 0.60288, a standard deviation of 0.21076, a minimum value of 0.00061, and a maximum value of 2.10529. This reflects the variation in the allocation of funds the central government provides to local governments. Local Own Revenue (PAD) has a mean of 0.13981, a standard deviation of 0.15603, a minimum value of 0.00549, and a maximum value of 2.79521, indicating differences in the ability of regions to raise revenue. Area (AREA) has a mean of 6.62902, a standard deviation of 1.58575, a minimum value of 2.80093, and a maximum value of 10.77478, illustrating significant geographical differences across regions. Population (POP) has a mean of 13.65984, a standard deviation of 0.99522, a minimum value of 11.60914, and a maximum value of 17.50154, indicating variations in population numbers across different regions.

Environmental Regulation and Environmental Goals

The regression results show that the relationship between waste generation (GENWAS) and Regional Regulation for Circular Economy (PERDA) is positive, although the presence of PERDA should be expected to reduce waste generation. Similarly, the relationship between waste generation and the Central Government Regulation for Circular Economy Regulation in Regions (PERMENDAGRI) is also positive, indicating that the implementation of the regulation could have been more effective in reducing waste generation. The regression results show that the relationship between GENWAS and the General Allocation Fund (DAU) is negative and significant, with a coefficient of -9.371, indicating that the greater the allocation of funds, the lower the level of waste generation. This illustrates the positive influence of

DAU in supporting better waste management. In addition, the relationship between waste generation and Regional Original Revenue (PAD) is positive and significant, with a coefficient of 12.99. This shows that an increase in PAD can increase waste generation, which may be caused by economic growth that needs to be managed sustainably. The relationship between waste generation and Population (POP) is also positive and significant, with a coefficient of 36.07. This illustrates that an increase in population can potentially increase waste generation, emphasizing the importance of effective waste management as the population grows. The selected model in this analysis is the Fixed Effect Model, which accommodates unobservable differences in characteristics between regions. This model allows for assessing the effect of variables that change over time on the level of waste generation.

Table 3: Regression Results of the Effect of Environmental Regulation on Environmental Objectives - Waste Generation

	CEM	**FEM**	**REM**
	GENWAS	GENWAS	GENWAS
PERDA	7.236***	6.974***	7.698***
	(11.54)	(10.97)	(12.30)
PERMENDAGRI	4.077***	1.172*	2.909***
	(6.49)	(1.90)	(4.82)
DAU	-7.060***	-9.371***	-9.858***
	(-4.47)	(-5.88)	(-6.28)
PAD	5.049**	12.99***	11.97***
	(2.63)	(6.40)	(6.05)
AREA	0.722**	-3.244	1.231**
	(2.05)	(-0.62)	(2.17)
POP	-2.387***	36.07***	-3.646***
	(-3.66)	(5.72)	(-3.74)
_CONS	32.42***	-464.6***	47.46***
	(4.40)	(-5.12)	(4.50)
N	779	779	779
Prob > F	0.000	0.000	0.000
	Chow Test	***LM Test***	***Hausman Test***
Prob > F	0.000	0.000	0.000
Model Estimation	FEM	REM	FEM

Source: Processed by the author with STATA 15

t statistics in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.001$

This study's findings need to be more consistent in the effectiveness of environmental regulations in reducing waste generation. Although previous literature emphasizes the positive role of environmental regulation in reducing negative environmental impacts (Shang et al., 2022; Curtis & Lee, 2019), in the context of PERDA and PERMENDAGRI, the results

of this study found a positive relationship with waste generation. In contrast, an increase in general allocation funds (DAU) is associated with a decrease in waste generation, in line with the view of the literature that government budget support can accelerate green growth (Safitri et al., 2021; Khan et al., 2021). In addition, the results show that an increase in local own-source revenue (PAD) is positively associated with waste generation. This may be due to economic growth that needs to be managed sustainably, in line with previous studies that emphasize the importance of efficient resource management in a circular economy (Lin et al., 2001; Wu & Dunn, 1995). Finally, the positive relationship between population growth and waste generation underscores the urgency of effective waste management in supporting population growth, a view also supported by the literature (Luo et al., 2021).

Environmental Regulation and the Circular Economy (Economic Goals)

Table 4: Regression Results of the Effect of Environmental Regulation on Economic Goals - Circular Economy

	CEM	**FEM**	**REM**
	CEGRDP	CEGRDP	CEGRDP
PERDA	0.269**	0.297**	0.288**
	(2.26)	(2.17)	(2.32)
PERMENDAGRI	23.57***	23.52***	23.57***
	(229.34)	(208.89)	(229.25)
GENWAS	0.0129**	0.0105	0.0123*
	(2.05)	(1.48)	(1.91)
AREA	-0.334***	3.277**	-0.329***
	(-6.77)	(3.12)	(-5.18)
POP	0.741***	1.303	0.735***
	(9.41)	(1.04)	(7.23)
_CONS	-7.894***	-39.47**	-7.836***
	(-9.71)	(-2.19)	(-7.48)
N	779	779	779
R^2-adj	0.991	0.992	
Prob > F	0.000	0.000	0.000
	Chow Test	***LM Test***	***Hausman Test***
Prob > F	0.0017	0.0243	0.0261
Model Estimation	FEM	REM	FEM

Source: Processed by the author with STATA 15

t statistics in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.001$

The regression analysis results show that the relationship between Circular Economy GRDP Growth (CEGRDP) and the Existence of Local Regulations for Circular Economy (PERDA) is positive and significant, with a coefficient of 0.297. Furthermore, the relationship between CEGRDP and the Existence of Central Government Regulations for Circular Economy Regulation in Regions (PERMENDAGRI) is also positive and significant, with a coefficient value of 23.52, which indicates that an increase in PERMENDAGRI has a positive impact on

CEGRDP. Regarding the relationship between CEGRDP and Waste Generation (GENWAS), the results of the Common Effect Model and Random Effect Model show significance, while in the Fixed Effect Model, it is not significant. The value of the relationship between these two variables is positive, which indicates that an increase in CEGRDP is associated with an increase in waste generation. From the analysis results, government policies, through PERDA and PERMENDAGRI, have a positive influence on circular economy growth. However, it should be noted that an increase in CEGRDP is also associated with increased waste generation. In this case, the researcher further investigated the influence of environmental regulations on the circular economy, disaggregating the results for municipalities and districts.

The regression analysis results indicate that the connection between growth in CEGRDP and the existence of PERDA and PERMENDAGRI positively affects circular economy growth. This discovery aligns with earlier literature that highlights the crucial function of environmental legislation in diminishing harmful environmental effects and bolstering green and sustainable economic expansion (Pan et al., 2021; Shao et al., 2020). Moreover, promoting innovation and sustainable technology development through policies can hasten the shift towards a circular economy (De Jesus & Mendonça, 2018; Di Maio & Rem, 2015). However, a rise in CEGRDP is linked to a growth in waste production, highlighting the significance of regulations encouraging eco-friendly practices, as proposed by Lin et al. (2001) and Wu & Dunn (1995). Referring to the literature, it has been established that government support for environmental policies and budgets is indispensable in achieving a sustainable circular economy (Pan et al., 2021; Shao et al., 2020). However, different findings indicate discrepancies in fiscal policy implementation and methodology in the context of government spending and its impact on economic growth (Onifade et al., 2020; Usman, 2011). Therefore, although PERDA and PERMENDAGRI have had a positive impact, the government must assess how budget allocations can optimize the circular economy's growth while reducing detrimental environmental effects.

Environmental Regulation and Social Goals

The regression analysis results indicate that the relationship between Life Expectancy (LE) and the Presence of Local Regulations for the Circular Economy (PERDA) is not significant, suggesting that local regulations in the context of the circular economy do not significantly impact life expectancy improvement. Meanwhile, the relationship between LE and the Presence of Central Government Regulations for Circular Economy Regulation in the Regions (PERMENDAGRI) is positive and significant, with a coefficient value of 2.892. From these results, it can be observed that central government policies regarding circular economy regulation in the regions positively affect the increase in life expectancy. This demonstrates the importance of coordination between the central and regional governments in implementing circular economy policies that directly impact community welfare, such as life expectancy.

Based on the results of the regression analysis, it was found that the relationship between Life Expectancy (LE) and the presence of Local Regulations for Circular Economy (PERDA) is not significant, indicating that local regulations in the context of circular economy do not have a significant impact on increasing life expectancy. Meanwhile, the relationship between LE and the presence of Central Government Regulation for Circular Economy Regulation in Regions (PERMENDAGRI) is positive and significant. This finding is in line with the literature that states the importance of environmental regulation in mitigating negative environmental impacts and reducing the use of natural resources (Shang et al., 2022). Previous studies have confirmed the positive functions of environmental regulation, such as improving environmental efficiency and reducing pollution (Curtis & Lee, 2019; Galloway & Johnson, 2016). In the circular economy context, environmental regulations encourage industries to implement environmentally friendly practices, such as reducing waste and using green technologies (Lin et al., 2001; Orange & Cohen, 2010). Furthermore, cooperation between central and local governments is crucial in implementing circular economy policies that directly impact people's welfare (De Jesus & Mendonça, 2018; Di Maio & Rem, 2015). Government

budget support is also key in realising a sustainable circular economy (Pan et al., 2021; Shao et al., 2020). Therefore, governments, businesses, and communities must jointly develop effective regulations to achieve an inclusive and sustainable circular economy. This research adds the insight that regulations from the central government have a more significant impact in increasing life expectancy than local regulations.

Table 5: Regression Results of the Effect of Environmental Regulation on Social Goals - Community Wellbeing

	CEM	**FEM**	**REM**
	LE	LE	LE
PERDA	-0.377	0.110	0.278**
	(-1.55)	(0.97)	(2.40)
PERMENDAGRI	3.327***	2.892***	3.103***
	(13.69)	(26.35)	(27.93)
DAU	-3.301***	-2.356***	-2.739***
	(-5.39)	(-8.33)	(-9.41)
PAD	1.486**	0.184	0.653*
	(2.00)	(0.51)	(1.76)
AREA	-0.942***	3.977***	-1.327***
	(-6.91)	(4.27)	(-3.32)
POP	0.547**	8.559***	1.944**
	(2.17)	(7.65)	(3.08)
_CONS	67.98***	-74.35***	51.17***
	(23.85)	(-4.61)	(7.61)
N	779	779	779
R^2-adj	0.482	0.819	
Prob > F	0.0000	0.0000	0.0000
	Chow Test	***LM Test***	***Hausman Test***
Prob > F	0.000	0.000	0.000
Model Estimation	FEM	REM	FEM

Source: Processed by the author with STATA 15

t statistics in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.001$

Fiscal Policy Mix and Environmental Goals

The regression analysis results reveal a significant relationship between Waste Generation (GENWAS) and Government Expenditure for the Environment (ENVEXP), as well as the Special Allocation Fund for the Environment (SPAENV). There is a positive and significant correlation between GENWAS and ENVEXP, indicating that increased government spending on the environment is associated with a rise in waste generation. This relationship suggests that when government expenditure for the environment increases, waste generation also experiences growth. These findings imply that the government needs to consider more effective

strategies in managing environmental expenditures to reduce waste generation. Enhancing efficiency, employing eco-friendly technologies, and supporting policies for sustainable waste management can help achieve this objective. On the other hand, the relationship between GENWAS and SPAENV is negative and significant, indicating that the larger the special allocation fund for the environment, the lower the waste generation. These findings suggest that as the special allocation fund for the environment increases, the generated waste decreases. The implication of this result is that the special allocation fund for the environment has successfully helped reduce waste generation. Therefore, increasing this fund allocation aligns with the government's efforts to minimize the negative impact of waste on the environment. Targeted and efficient allocation strategies in environmental management will significantly contribute to reducing waste generation and supporting the circular economy concept.

Table 6: Regression Results of the Effect of Fiscal Policy Mix on Environmental Objectives - Waste Generation

	CEM	**FEM**	**REM**
	GENWAS	GENWAS	GENWAS
ENVEXP	26.89**	20.17**	22.78**
	(3.05)	(2.41)	(2.57)
SPAENV	-366.2**	-270.1**	-309.5**
	(-2.52)	(-2.19)	(-2.30)
DAU	-21.10***	-15.68***	-23.47***
	(-14.97)	(-10.58)	(-17.57)
PAD	12.14***	16.68***	20.41***
	(5.68)	(7.75)	(9.50)
AREA	2.596***	1.466	2.938***
	(6.52)	(0.26)	(4.71)
POP	-6.042***	60.97***	-7.006***
	(-8.59)	(9.63)	(-6.66)
_CONS	81.24***	-830.5***	92.48***
	(10.81)	(-9.07)	(8.36)
N	780	780	780
R^2-*adj*	0.274	0.449	
Prob > F	0.000	0.000	0.000
	Chow Test	***LM Test***	***Hausman Test***
Prob > F	0.0000	0.0000	0.0000
Model Estimation	FEM	REM	FEM

Source: Processed by the author with STATA 15

t statistics in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.001$

Previous literature underlines the role of environmental regulation in reducing negative environmental impacts and advancing the circular economy (Shang et al., 2022; Curtis & Lee,

2019). In the context of a circular economy, these regulations encourage industries to adopt environmentally friendly practices such as waste reduction and green technology integration (Lin et al., 2001; Orange & Cohen, 2010). On the other hand, some literature emphasizes that government spending support can accelerate economic growth (Aminah, 2016; Safitri et al., 2021). However, our results show that increased environmental spending brings the potential for increased waste disposal. This emphasizes the need for more effective strategies in managing environmental spending. Therefore, the collaboration between environmental regulation and appropriate fiscal policy is critical in realizing inclusive and sustainable economic growth (Pan et al., 2021; Shao et al., 2020; X. Zhao et al., 2022). In a circular economy framework, fiscal policies that include green initiatives such as funding for green technology R&D can accelerate green economic growth (Khan et al., 2021; Ngan et al., 2019).

Fiscal Policy Mix and the Circular Economy (Economic Goals)

Table 7: Regression Results of the Effect of Fiscal Policy Mix on Economic Goals - Circular Economy

	CEM	FEM	REM]
	CEGRDP	CEGRDP	CEGRDP
ENVEXP	-6.232	-5.943	-6.232
	(-0.56)	(-0.53)	(-0.56)
SPAENV	-837.6***	-651.0***	-837.6***
	(-4.55)	(-3.92)	(-4.55)
DAU	-39.12***	-32.44***	-39.12***
	(-21.94)	(-16.24)	(-21.94)
PAD	16.42***	19.34***	16.42***
	(6.07)	(6.67)	(6.07)
AREA	3.648***	13.91*	3.648***
	(7.24)	(1.83)	(7.24)
POP	-8.597***	83.38***	-8.597***
	(-9.66)	(9.77)	(-9.66)
_CONS	128.0***	-1200.9***	128.0***
	(13.46)	(-9.73)	(13.46)
N	780	780	780
R^2-adj	0.418	0.551	
Prob > F	0.000	0.000	0.000
	Chow Test	***LM Test***	***Hausman Test***
Prob > F	0.0000	1.0000	0.0000
Model Estimation	FEM	CEM	FEM

Source: Processed by the author with STATA 15

t statistics in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.001$

The analysis results indicate that the relationship between Circular Economy GDP

(CEGRDP) and Government Expenditure on the Environment (ENVEXP) is negative and not significant. This finding suggests that increasing government spending on the environment does not directly influence the growth of GDP in the circular economy sector. Therefore, alternative approaches need to be explored to integrate environmental policies with circular economic growth. Attention must be given to the development of innovative strategies and collaborations to achieve a more sustainable and resource-efficient economy. Ultimately, a comprehensive and well-coordinated approach will be essential for successfully combining environmental policies with circular economic growth. On the other hand, there is a significant negative relationship between Circular Economy GDP (CEGRDP) and the Special Allocation Fund for the Environment (SPAENV). This result suggests that as the allocation of funds for the environment increases, the growth of GDP in the circular economy sector decreases. The implication of this finding is the need for more efficient and effective environmental fund management to optimally support circular economic growth. In this context, it is crucial for the government and relevant stakeholders to formulate strategies that integrate environmental policies with circular economy development efforts, aiming to create sustainable and environmentally friendly economic growth.

The results show a negative and insignificant relationship between Circular Economy GDP (CEGRDP) and Government Expenditure on the Environment (ENVEXP). This finding contrasts with previous literature that emphasizes the importance of environmental regulation in supporting sustainable economic growth (Shang et al., 2022; Pan et al., 2021). Previous studies have also emphasized the critical role of government budget support in accelerating economic growth (Aminah, 2016; Safitri et al., 2021). However, this finding suggests that alternative approaches may be needed to integrate environmental policies with circular economy growth. Furthermore, findings showing a significant negative relationship between CEGRDP and SPAENV highlight the need for more efficient management of environmental funds (Khan et al., 2021; Ngan et al., 2019). Although some previous studies have shown a positive relationship between government spending and economic growth (Onifade et al., 2020; Zhang et al., 2021), these findings suggest that fiscal policy implementation and methodology have significantly different outcomes in the circular economy context.

Fiscal Policy Mix and Social Goals

The results of a regression analysis show that the relationship between life expectancy (LE) and government expenditure on the environment (ENVEXP), calculated as the ratio of government expenditure on the environment to the total expenditure of a local government, is not significant. This suggests that the proportion of local government budgets allocated to environmental expenditure has not yet reached a level that can significantly improve social welfare. In addition, this finding suggests that a greater emphasis on environmental spending may be required to observe a significant impact on life expectancy.

Similarly, the central government's special allocation of environmental funds to local governments (SPAENV), calculated as the ratio of the central government's special allocation of environmental funds to local governments to a local government's total expenditure, has ano correlation with LE. This suggests that the allocation of special funds for the environment has yet to improve the quality of life of the general population significantly. The relationship between LE and the General Allocation Fund (DAU) was negative and significant because DAU is not used exclusively for social purposes. In addition, the relationship between LE and Regional Original Revenue (PAD) is positive and significant. Since LE is positively correlated with PAD, an improvement in individuals' quality of life and well-being will be followed by an increase in PAD. Life expectancy is a crucial measure of social development goals. As a reflection of the population's quality of life, a high LE indicates a high standard of living, which positively impacts regional economic growth. Income levels, which represent a community's purchasing power and economic capacity, are often used as a proxy for community wealth. Several studies have found that an increase in wealth leads to an increase in PAD (Rosita &

Sutrisna, 2018; Sembiring, 2019; Utami & Indrajaya, 2019). A healthy and wealthy community will be more productive and better able to contribute to regional economic development through productive activities and consumption. In the long term, increased community wealth will lead to increased investment in both physical and social infrastructure, which will support the expansion of PAD.

Table 8: Regression Results of the Effect of Fiscal Policy Mix on Social Goals - Community Wellbeing

	CEM	**FEM**	**REM**
	LE	LE	LE
ENVEXP	-1.759	1.799	2.413
	(-0.53)	(0.92)	(1.11)
SPAENV	-110.2**	-21.74	-24.93
	(-2.00)	(-0.76)	(-0.78)
DAU	-8.396***	-6.392***	-8.682***
	(-15.76)	(-18.46)	(-26.18)
PAD	3.444***	2.529***	4.505***
	(4.26)	(5.03)	(8.48)
AREA	-0.452**	4.684***	-1.752***
	(-3.00)	(3.56)	(-3.74)
POP	-0.638**	19.01***	2.232**
	(-2.40)	(12.85)	(2.97)
_CONS	85.51***	-218.1***	54.85***
	(30.09)	(-10.19)	(6.93)
N	780	780	780
R^2-*adj*	0.353	0.629	
Prob > F	0.0000	0.0000	0.0000
	Chow Test	***LM Test***	***Hausman Test***
Prob > F	0.0000	0.0000	0.0000
Model Estimation	FEM	REM	FEM

Source: Processed by the author with STATA 15

t statistics in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.001$

Robustness Test

In robustness tests conducted to verify the impact of fiscal policy mix and environmental regulation on the circular economy in East Java, the researchers used other proxies, namely waste generation per GDP (GWGRDP) and growth of circular economy GDP (RATECEGRDP). The results obtained are the same as the previous test, which shows the reliability of these findings. The relationship between local regulations for the circular economy (PERDA) and GWGRDP and RATECEGRDP is positive, indicating that PERDA plays a role in promoting the circular economy. Furthermore, the relationship between Central Government Regulations

for Circular Economy Regulation in Regions (PEMENDAGRI) and GWGRDP and RATECEGRDP is also positive, confirming the importance of coordination between central and local governments in implementing a circular economy. Meanwhile, the relationship between the Special Allocation Fund for the Environment (SPAENV) to GWGRDP and RATECEGRDP is negative, suggesting that SPAENV may need to be more efficient and effective in promoting circularity. In the context of the Special Allocation Fund (DAU), the relationship with GWGRDP and RATECEGRDP is also negative, suggesting the need for further evaluation of the allocation and use of DAU in supporting the circular economy. Finally, the relationship of Local Owned Revenue (PAD) to GWGRDP and RATECEGRDP is positive, suggesting that local revenue sources have the potential to drive the circular economy if allocated effectively.

Table 9: Robustness Test with Dependent Variable = GWPGRDP

	CEM	**FEM**	**REM**	**CEM**	**FEM**	**REM**
	GWPGRDP	GWPGRDP	GWP-GRDP	GWPGRDP	GWPGRDP	GWPGRDP
PERDA	2.432***	2.541***	2.546***			
	(8.24)	(7.78)	(8.39)			
PERMENDAGRI	1.426***	1.268***	1.370***			
	(5.40)	(4.41)	(5.38)			
AREA	0.414***	-2.619	0.379	1.039***	-0.776	1.199***
	(3.08)	(-0.96)	(1.48)	(5.78)	(-0.28)	(4.23)
POP	-0.824***	1.583	-0.773*	-2.088***	8.644***	-2.477***
	(-3.83)	(0.51)	(-1.89)	(-6.57)	(2.75)	(-4.58)
ENVEXP				6.152	6.709	6.531**
				(1.54)	(1.61)	(2.53)
SPAENV				-119.0*	-72.55	-86.66***
				(-1.81)	(-1.18)	(-2.95)
DAU				-5.293***	-4.940***	-6.070***
				(-8.31)	(-6.71)	(-6.76)
PAD				2.272**	4.452***	4.701***
				(2.35)	(4.16)	(3.08)
_CONS	8.598***	-4.112	8.133*	25.97***	-109.1**	30.35***
	(3.87)	(-0.09)	(1.93)	(7.65)	(-2.40)	(5.16)
N	779	779	779	780	780	780
R^2-*adj*	0.218	0.198		0.100	0.124	
Prob > F	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Source: Processed by the author with STATA 15

t statistics in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 10: Robustness sTest with Dependent Variable = RATECEGRDP

	CEM	FEM	REM	CEM	FEM	REM
	RATECEGRDP	RATECEGRDP	RATECEGRDP	RATECEGRDP	RATECEGRDP	RATECEGRDP
PERDA	0.0000718	0.0000154	0.000000283			
	(0.99)	(-0.20)	(0.00)			
PER-MEND-AGRI	0.00132***	0.00139***	0.00135***			
	(20.97)	(21.55)	(22.69)			
GENWAS	-0.0000168***	-0.0000147***	-0.0000165***			
	(-4.39)	(-3.62)	(-4.33)			
AREA	-0.000209***	0.000821	-0.000193***	0.0000196	0.00141*	0.0000185
	(-6.94)	(1.37)	(-3.12)	(0.43)	(1.90)	(0.29)
POP	0.000125***	-0.000856	0.000103	-0.000367***	0.00349***	-0.000379***
	(2.59)	(-1.20)	(1.04)	(-4.53)	(4.17)	(-3.44)
ENVEXP				0.00164	-0.000253	0.000680
				(1.61)	(-0.23)	(0.64)
SPAENV				-0.0384**	-0.0257	-0.0313*
				(-2.29)	(-1.58)	(-1.91)
DAU				-0.00178***	-0.00141***	-0.00187***
				(-10.95)	(-7.22)	(-11.55)
PAD				0.000956***	0.000850***	0.00115***
				(3.88)	(2.99)	(4.45)
_CONS	-0.000313	0.00623	-0.000120	0.00646***	-0.0555***	0.00668***
	(-0.63)	(0.61)	(-0.12)	(7.46)	(-4.60)	(5.73)
N	779	779	779	780	780	780
R^2-*adj*	0.475	0.473		0.213	0.164	
Prob > F	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Source: Processed by the author with STATA 15

t statistics in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Discussion

The findings in this study that examine the effect of fiscal policy mix and environmental regulation on the circular economy suggest significant findings for East Java. The circular

economy, proxied by the GRDP of the water supply, waste management, waste, and recycling business sectors, is strongly influenced by environmental regulations. In this context, environmental regulation includes policies made by local and central governments. These policies create a conducive environment for circular economy growth while protecting natural resources and ecosystems. One example of a policy that has a positive impact on the circular economy is the waste management policy at the local level. These policies create incentives for businesses to reduce waste and promote recycling, thereby reducing the negative impact of waste on the environment. Over time, this policy can result in the sustainable growth of the circular economy.

Fiscal policy at the regional level plays an essential role in directly influencing the circular economy in the region. In this context, the variable that positively impacts the circular economy's viability is local revenue (PAD). PAD is a regional financial indicator that reflects the ability of the region to raise resources to support development policies and programs. The role of PAD in local finance is critical, as the source of funding generated by PAD determines the quality and continuity of policies and programs implemented by local governments. The higher the PAD, the greater the regional fiscal power available in various sectors, including the circular economy. In the circular economy context, a high PAD is expected to contribute to the local economy by supporting investment and innovation in environmentally friendly and sustainable sectors. Local authorities can use PAD funds to develop green infrastructure, promote the use of renewable energy, and encourage efficient recycling and waste management practices.

There are three main dimensions of sustainable development: environmental, economic and social. These three dimensions are interrelated and need to be managed in a balanced way in order to achieve sustainable and inclusive development. This research examines these three dimensions concerning the circular economy. The environmental dimension is illustrated through efforts to reduce the amount of waste in the region, which is one of the critical indicators of sustainable environmental management. Meanwhile, the economic dimension is realized through the gross domestic product of the water supply, waste management, waste, and recycling sectors. In the context of a circular economy, these sectors are essential pillars in transforming towards a more environmentally friendly development.

The social dimension is proxied by high life expectancy, which reflects people's quality of life and access to adequate health and education services. This study found that the social dimension is influenced by environmental regulations at both local and central government levels. These environmental regulations play a role in creating an environment conducive to sustainable development and community well-being. In addition, the social dimension is also influenced by the local government's revenue (PAD). PAD is an essential source of funding for local governments to carry out various development programs, including improving the community's quality of life.

Interestingly, the environmental dimension in this study is influenced by the fiscal policy mix of the central government, namely through the General Allocation Fund (DAU) and the Special Allocation Fund for the Environment (DAK). These two types of funds are strategic instruments for supporting environmental management and sustainable development efforts at the regional level. In this context, the DAU and DAK act as a source of funding that allows local governments to allocate resources more effectively in implementing programmes related to environmental management. This includes policies on waste management, provision of clean water, waste management, and recycling. In this context, DAU and DAK act as a source of funding to enable local governments to allocate resources more effectively in implementing environmental management programmes. This includes policies on waste management, clean water supply, waste management, and recycling.

In the previously presented research results, there are differences in the significance and direction of the relationship between area and waste generation in three different econometric models. In the Common Effect Model, the relationship is positive and significant,

indicating that as area increases, waste generation tends to increase. However, in the Fixed Effect Model, the relationship becomes negative although not significant, while in the Random Effect Model, the relationship is again positive and significant. This difference may result from the way each model handles unobserved heterogeneity. The Common Effect Model does not consider heterogeneity between areas, so it may provide biased estimates. The Fixed Effect Model, on the other hand, considers fixed heterogeneity between areas that could affect waste generation. While Random Effect views heterogeneity as a random effect. Since the Hausman test shows that the Fixed Effect model is more appropriate, it can be concluded that there are unobserved fixed factors that are correlated with area, affecting waste generation.

Conclusion

This research aims to provide a more holistic understanding of how environmental and fiscal policies can complement each other to promote a circular economy in East Java by combining both aspects. This research is expected to generate policy recommendations for central and local governments and identify opportunities and barriers to implementing a circular economy in East Java. In addition, this research will significantly contribute to developing literature on circular economy and environmental and fiscal policies at local and national levels. The study found that the circular economy, represented by the Gross Regional Domestic Product (GRDP) of the water supply, waste management, and recycling business sectors, is strongly influenced by environmental regulations. These regulations include central and local government policies that create an enabling environment for the growth of the circular economy while protecting natural resources and ecosystems.

Fiscal policies at the local level play an important role in influencing the circular economy in the area. In this context, one variable that positively impacts the sustainability of the circular economy is Local Owned Revenue (PAD). PAD is a regional financial indicator that reflects the ability of a region to raise resources to support development policies and programs. Sustainable development has three main dimensions: environmental, economic, and social. These interrelated dimensions must be balanced to achieve sustainable and inclusive development. This research examines these three dimensions in the context of the circular economy. The environmental dimension is illustrated through efforts to reduce the amount of waste in the region, an essential indicator of sustainable environmental management. Meanwhile, the economic dimension is realized through the GDP of the water supply, waste management, and recycling sectors. The social dimension is represented by high life expectancy, which reflects people's quality of life and access to adequate health and education services. Interestingly, the environmental dimension in this study is influenced by central fiscal policy through the General Allocation Fund (DAU) and the Special Allocation Fund for the Environment (DAK). These two types of funds are strategic instruments to support environmental management and sustainable development efforts at the regional level. In this context, the DAU and DAK serve as sources of funding that enable local governments to allocate resources more effectively in implementing programmes related to environmental management.

Research Limitations and Future Research

This study acknowledges several limitations that must be considered, particularly in relation to the data, methods, and proxies employed. One significant data limitation is the lack of Gross Regional Domestic Product (GRDP) data explicitly originating from the circular economy sector. Instead, the data utilized is integrated with the Water Supply, Waste Management, Waste, and Recycling Business Sector. This inevitably affects the precision in assessing the circular economy's impact. Concerning the methodology, the present study has not incorporated dynamic effects into the econometric model. Analyzing dynamic effects is crucial, as fluctuations in the circular economy can be influenced by evolving internal and external factors. With respect to proxies, this study relies on dummy variables to gauge the effectiveness of environmental regulations. However, dummy variables are limited in their

capacity to capture the intricacies and variations in the success of such regulations. In light of these limitations, future research should employ more suitable and precise proxies to evaluate the success of environmental regulations in shaping the circular economy. This is essential to offer more effective and efficient policy recommendations that promote a sustainable circular economy. Furthermore, future studies should also account for dynamic effects in econometric models to yield more relevant and comprehensive results.

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