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Perspectives on the impact of financial public policy in advancing circular economy

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Abstract:

Objective*: The transition to the circular economy is an important strategic objective of the European Union, supporting eventually most of the sustainable development objectives. The objective of the paper is to analyse the importance and potential role of the public financial policy, to foster or promote the environmental, economic and social benefits of a circular economy (CE), in view of a fast and efficient transition in the EU countries;*

Method*: The methodological approach is based on literature review, database creation, statistical and economic analysis of indicators. There are first stated some conceptual grounds of the circular economy pillars and features, followed by principles and trends of circular economy public financial policies and instruments in the European Union. In order to estimate a panel regression model that describes the influence of public finance on the circular economy, the last sections deal with the evolution 2009-2020 of main indicators, as well as with the econometric model.*

Results*: The regression model indicated that increases in taxation or government output, above a certain limit, would lead to a reduction in the degree of circularity. It is more advisable that the Taxes on Production and Imports (TPI) and the General Government Output (GGO) are kept at relatively moderate values for the circular economy to develop.*

Originality*: In this original approach, the influence of financial policies on the circular economy was analysed through the lens of two indicators: General Government Output (GGO) and Taxes on Production and Imports (TPI), both expressed as a percentage of GDP (%). These indicators were used in the regression model as determinant proxy variables for the determined circularity variable Circular Material Use Rate (CMUR %, as CE synthetic indicator).*

Keywords: *circular economy; financial public policies; financial instruments; statistical indicators*

JEL Classification: *G28, H30, H57, Q56*

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Introduction

The concept of circular economy (CE) represents the new economic paradigm that seeks to maximize the resources utilization through their recovery and recycling in production, considering the limited natural resources and the value retained by products at their end of life.

Moreover, the circular economy asserted itself as the EU's strategic directions gradually aimed at raising resource productivity and eco-innovation in the economy, and also lowering the ecologic footprint. A circular economy model can be the ideal solution in sustainable relaunch of the European Union's economy, as shown in the strategic document "Closing the loop – An EU action plan for the circular economy" (2015). This also is the reason why the circular economy is one of the main objectives of the "European Green Deal" (2019).

Due to the decisive role of a well-designed policy mix, the most recent Action plan for CE (COM 2020 98 final) mentions the "economic empowerment “principle, meaning a wider use of economic and financial instruments in the circular economy.

Although research and study on the role and influence of the financial and environmental policies in the CE development has been increasing lately, the evidence, mainly empirical, on this topic is still scarce. The research gap justified the main objective of this research paper, namely to identify how financial policies influence the EU circular economy, by country groups and in Romania. The research hypothesis is that financial policy influences progress on the circular economy of national economies in the European Union countries.

The methodology used is based on the following:

- Literature review – study and analysis of specialized literature on public financial policies and fiscal instruments for the CE transition.
- Creating a database, with the relevant analysis indicators, for the financial (fiscal-budgetary) policy of EU states, from the perspective of the circular economy, extracting data for the analysed indicators, by accessing the GFS (Government Finance Statistics) public finance database and CEI (Circular Economy Indicators) from Eurostat.
- Economic and statistical static and dynamic analysis, for the EU member states, of the evolution in the 2009-2020 period of some indicators considered relevant for public financial policies from a circular economy perspective: General government output; Taxes on production and imports; The materials use rate (CMUR).
- The chosen indicators can be used in the regression analysis as exogenous (independent) and endogenous (dependent) proxy variables, for some levers or financial public policy instruments, considered relevant in the transition to the circular economy.

The methodology used in econometric analysis involves the method of least squares (OLS), for panel data series. The coverage area is represented by 27 EU countries.

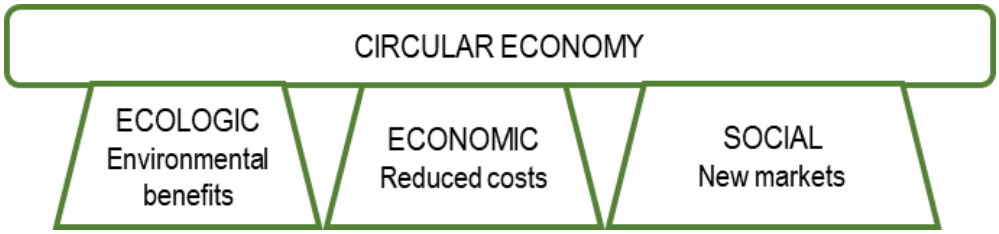
1. Literature review

According to the current definition published by the European Parliament, CE is a production and consumption model involving repair, refurbish, share, rent, recycle and reuse of products as much as possible. This way, it may be obtained an extension of their life cycle. Actually, CE involves minimizing waste. When reaching its life cycle end, the CE loop keeps its material utility by recycling them again and again in production (Frone and Frone, 2020).

It can be stated that CE transition is based on three main pillars (Figure 1), somewhat similar to the sustainable development pillars:

1. environmental benefits strengthen the Ecologic pillar, especially in terms of lowering resources consumption and implicitly its negative impact on the environment;
2. cost savings generated by lower needs for natural resources, strengthen the Economic pillar of the circular economy;
3. development of new markets, creating jobs or value, constitutes the social pillar.

Figure 1: Circular Economy Pillars



Source: Own compilation from (Taranic I. et al, 2016).

Public policies are meant to favour the strengthening of these three components sustaining CE transition (Behrens, 2016).

In this respect, for each pillar, there are some specific policy instruments described in the specialized literature:

- For the ecological or environmental benefits pillar, the environmental policies and instruments used are: mandatory and/or voluntary targets for resource use, eco-labelling, circularity indicators.
- For the cost savings pillar, the fiscal instruments and policies proposed can be the fiscal policy of shifting taxation from labour to natural resources.
- For the pillar of creating new markets, the following are used: the creation of partnerships or networks of industrial symbiosis with the various types of stakeholders, green public procurement contracts.

Furthermore, this paper will analyse how the fiscal-budgetary policy can contribute to the consolidation of the second (Economic) CE pillar, especially in the EU. Through the review of specialized literature, some conclusions or rather directions for more in-depth research on the correlation between fiscal policy and the circular economy can be highlighted.

Nevertheless, noting that in case of the EU, fiscal measures must be always adopted in every country, it is difficult to implement this type of policy at EU level. Instead, such measures are being implemented at national level in some EU countries, ahead in CE transition (CEPS, 2016).

Therefore, the basic elements of CE are: reducing the total consumption of materials; product reuse by extending product life through repair, refurbishing; recycling; recovery of materials in production and use processes. The recovery processes and measures, attempting to return materials and resources to the productive cycle should also mean to reduce their impact on the environment and health (Constantinescu A., 2013). In addition, CE is operationalized on various levels such as micro, meso and macro level (Ghisellini et al, 2016; Kirchherr et al, 2017).

At the same time, recent more in-depth research on the correlation between public policies and business models suitable for the circular economy (Wasserbaur et al, 2022; Platon et al, 2022, Platon et al, 2023; Constantinescu et al, 2022) confirmed the importance of these policy areas and highlighted new areas such as circular innovation. Financing innovation and supporting research or demonstrative projects is an important policy promoting innovative circular processes to market (Frone, 2017).

It is generally considered that the focus has been more on administrative solutions, including policy and informational tools, without fully capitalizing on CE financial and economic instruments (Hartley K, van Santen R, Kirchherr J, 2020).

On the other hand, although in literature there are discussions about CE dedicated environmental taxes and fees, for example in (Ekins et al, 2012, Andersen et al, 2014), in practice, the propensity to implement such measures continues to be limited (Andersen et al., 2014, Frone and Constantinescu, 2021).

The taxes on material resources internalize the social and environmental externalities of extracting natural resources, still they are considered the second choice for resource regulation policy (Söderholm, 2011) due to their "inherent imprecision". In this regard, the study (Domenech et al., 2019) analysed their several structural or information and incentive barriers.

To date, research on best policy instruments for circular economy is scarce, since few recent articles provide information on the tools needed to create comprehensive CE policy mixes (Wilts et al., 2019; Hartley et al., 2020).

However, Table 1 summarized some of the main policies or financial instruments needed to promote and stimulate the CE transition in the EU. As presented above, for the full life cycle

of the product but also for each phase of its life cycle, there are some specific policy recommendations and favourable instruments from the EC perspective.

Table 1. Fiscal and economic tools and policies for the circular economy

Product life cycle		
Production/ product design	**Use/consumption phase**	**Waste / End of Life**
Adoption of circular design norms and standards	Circular purchases and procurement	Lower VAT for products reused and containing recycled parts
Marketing campaigns and circular economy promotion	Green acquisition	Liberalized waste trade
Material flow accounting databases (MFA)		Development of commercial waste platforms
		Eco-industrial parks founding (industrial ecosystems)

Source: Own compilation and adaptation after (Milios, 2018) and (Hartley et al, 2020).

Furthermore, the conclusions and recommendations from the global specialized literature will be presented in more detail regarding the usefulness and character of the policy, measures and fiscal instruments in promoting the circular economy.

The public financial policy is part of the general policy of the state, fulfilling an important role for the implementation of economic and social development programs.

The basic methods or means regarding the procurement and management of financial resources, as well as the instruments, institutions and financial regulations used by the state to influence economic processes and social relations are components of the state's financial policy. The main objectives of financial policy in the market economy, identified by (Barrere, 1958) refer to:

- fostering economic progress through public finances;
- redistribution of resources through taxes and investments;
- achieving fiscal justice by taking transfers into account.

The first issue that arises, from the circular economy perspective, concerns what kind of instruments may be introduced in the taxation system.

Some studies have analysed the existing tax system and especially the existing environmental taxes aiming to research to what extent the most important taxes (VAT income corporate) may be replaced by more targeted resource taxation. There is still a need for deeper reform of the entire tac system in view of sustainable development and circular economy objectives (Frone et al., 2015).

The concept of extra fiscality is an approach showing that taxation should not be limited to raising public revenues, but also to reach other objectives of industrial, social or environmental policies (Aizega Zubillaga, 2001).

In the sense of the present research, we can emphasize the relevance of a certain type of extra-fiscal financial policy: fiscal spending instruments, meaning instruments targeting specific sectors or economic activities (Ashiabor, 2020).

Thus, in view of the green economy, there are tax reform proposals claiming a shift from labour taxation to resources and energy taxation (Paleocrassas, 1999; Cato, 1999; Frone et al., 2017). However, these proposals remain only theoretical outlines, without any progress in implementation.

For the CE promotion, the general principle of the tax system is to remove taxes imposing high costs on circular and renewable activities, at the same time increasing the taxes on capital and non-renewable resources (Andretta et al, 2018). As shown below, the current environmental taxation is still insufficient from a CE perspective, since it is generally focused only on taxing harmful environmental impact at the end of the production chain. This overlooks some important negative externalities coming from depletion of resources or from the increased quantities of waste.

Furthermore, based on the literature review, three reform possibilities are described for the purpose of environmental sustainability and circular economy.

a) Comprehensive taxes for all externalities

A notable holistic reform proposal is that of (Beeks et al., 2018), aiming not only to correct the worst environmental and resource impact but to transform the entire economy.

Basically, Beeks and Lambert (2018) proposed to estimate a factor of cost integrating all the production and consumption generated externalities. These would be cold externalities factors (for all the pollutants affecting every environmental sector).

b) Reduction of labour taxes simultaneously with taxation of natural resources

This is the ecological tax reform proposed and analysed in two recent works (Frone and Constantinescu, 2021; Frone et al., 2021), although, so far, it has not been observed a widespread implementation in the EU.

In this regard, Stahel (2013) created a new scheme, subsequently adapted to certain countries' conditions by Groothuis, F.; Damen, M. Ex'tax Project for the Netherlands (2014), The Ex'tax Project for Europe (2016) or Bangladesh (2019). Milios (2021) provides an interesting review of the tax on raw materials, the repair and waste hierarchy.

As Stahel (2019, p. 72) recently argued, "the linear economy is resource and capital intensive, while the circular economy is labour intensive. Current fiscal policies in many

countries impose high taxes on labour while subsidizing production and consumption of fossil fuels and other non-renewable resources. Reversing taxes on these two factors of production, favouring renewable resources, can provide economic agents with direct incentives to move towards circular economy and sustainability".

c) Replacing environmental taxation with circular taxation

According to the analysis and conclusions of the study (Vence et al, 2021, Frone et al, 2021), it can be deduced that a circular economy taxation should be more ambitious that the current environmental taxation.

Besides, although intended to reduce some externalities and change economic behaviour, current environmental taxes do not affect the linear basic structure of the economy (Mihai, Vasile et al, 2018).

In this respect, only the circular taxation may implement a radical economic structural change by changing the price ratio and implicitly the final business and consumption behaviour towards a sustainable economy.

2. Relevant indicators for the EU countries financial policy

This section will substantiate some of the most relevant indicators of public financial policy, highlighted by EU member states, from a policy perspective in support of the circular economy.

Integrated Government Finance Statistics (GFS) is a European Union-specific model of public accounts, showing the government's economic activities in a way that is suitable for fiscal analysis.

The public finance indicators (GFS) of the EU countries are defined by reference to the European System of National and Regional Accounts (ESNRA), which is the basis for fiscal monitoring in Europe, in particular for the procedure applicable to excessive deficits. In order to calculate the European public finance indicators, for the public administration sector the transactions recorded are compiled and presented in the various annual and quarterly financial and non-financial accounts of the European System of Accounts (ESA).

Government revenue consists of the sum of taxes, social net contributions, sales and other revenue and capital transfer.

Considering their impact on the fiscal policy from a circular economy perspective, suggested by the specialized literature, from the total revenues of the public administration, there will be analysed the following indicators: general government output (GGO) and taxes on production and imports (TPI).

These indicators will then be used as proxy variables of public financial policies in correlation with the most synthetic indicator of the circular economy, namely the Circular Material Use

Rate (CMUR) in order to be able to estimate the existence and intensity of some correlations between public financial (fiscal) policy and the transition to the circular economy, in the European Union.

2.1. General government output GGO (%GDP) – Issues and trends of the general government output in the EU

General government output (ESA indicator 2010 code P.1) represents f the products (and services) created by the institutional units of the public administration (i.e., units in the sub-sectors of central administration, state administration, local public administration or social insurance funds). The ESA 2010 indicator category P.1 includes three types of production: market production, production for own final use and non-commercial production.

a) Market production – consists of all products placed on the market or intended to be placed on the market, either by sale or by barter.
b) Non-commercial production refers to goods or services provided free of charge or at economically insignificant prices for another unit. Non-commercial production (P.13) is subdivided into payments for non-commercial production (P.131) and other non-commercial production (P.132) (Source: ESA 2010, point 3.18, 3.19).

Table 2. General government output (GGO), in the EU and the Eurozone (EA) (% GDP)

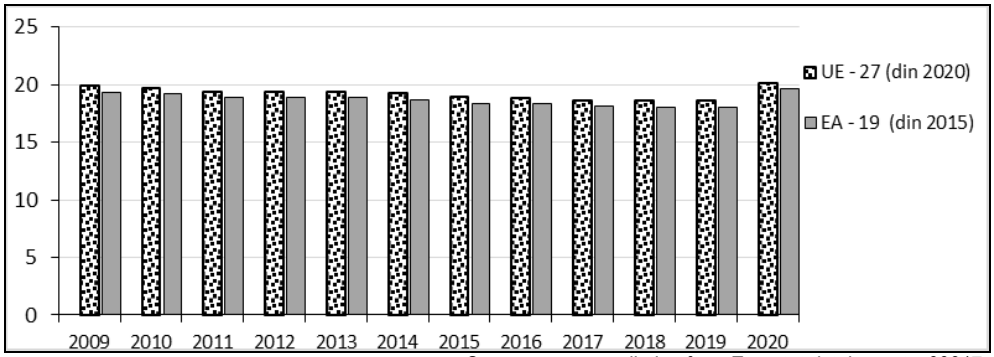
	2009	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	***Aver.***
UE	19.9	19.7	19.4	19.4	19.4	19.3	18.9	18.8	18.6	18.6	18.6	20.1	*19.22*
EA	19.3	19.2	18.9	18.9	18.9	18.7	18.4	18.3	18.1	18.0	18.0	19.6	*18.69*
Dif.	0.6	0.5	0.5	0.5	0.5	0.6	0.5	0.5	0.5	0.6	0.6	0.5	*0.53*
Min. UE	15.1	14.9	14.7	14.9	15.	14.9	12.4	12.5	12.	11.6	11.4	11.9	*13.44*
Max. UE	30.1	29.6	28.8	28.8	29.	28.8	28.5	27.6	26.7	26.7	26.8	28.	*28.28*
Romania	18.1	17.0	15.7	15.8	15.7	15.9	15.8	16.7	17.0	18.2	19.0	20.3	*17.1*

Source: own compilation from Eurostat database, tec0017

Regarding the evolution of the general government output (GGO) indicator, as a % of GDP, in the period 2009-2020, in Table 2 and Figure 2, some small differences can be observed between the aggregates of the EU (27 states) and respectively the Euro Area, EA-19 states), as well as the annual minimum and maximum values of this indicator, from the EU member states.

It can be observed that, from the point of view of the level reported as a percentage of GDP, in the period 2009-2020, the GGO had a slightly downward trend, both at EU level and in EA, with an average annual level in the EU of 19.22% (GDP) and respectively of 18.69% (GDP) in EA, so in the Euro zone the level of the indicator was at least 0.5% (GDP) lower, every year, 2009-2020. In 2020, this downward trend stopped and the indicator rose again to a level of over 20% (GDP) in the EU due to the Covid-19 pandemic, which increased the need for state intervention in the economy and services.

Figure 2. General government output, in the EU(UE-27) and the Eurozone (EA) (% GDP)

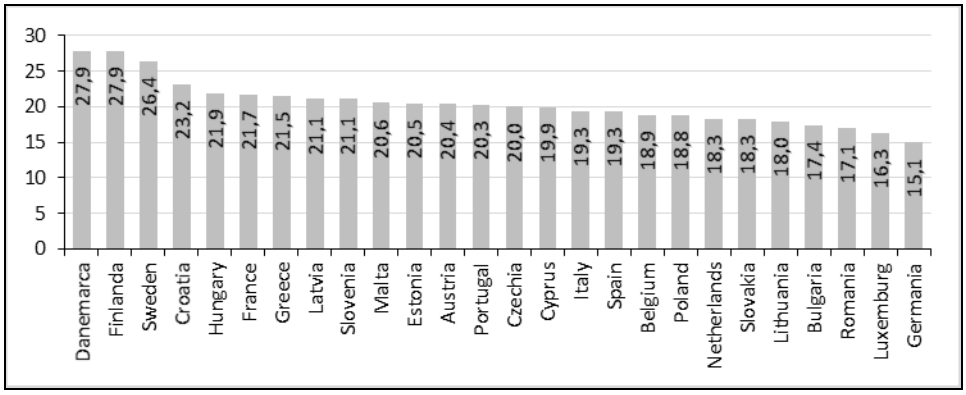


Source: own compilation from Eurostat database, tec00017.

From the point of view of the annual evolution, Table 2 shows also the annual evolution of the lowest (EU Minimum) and respectively the highest levels GGO in all EU countries. The EU minimum varies between 11.4% (GDP) of Ireland (in 2019) and up to 15.1% of Germany (in 2009). Peak values decreased from 30.1% (GDP) in Denmark in 2009 to 26.7% (GDP) in 2018 in Finland.

Annex 1 summarizes the evolution and dynamics of EU countries from the point of view of general government GGO production (% GDP). In Figure 3, the countries were highlighted, in descending order of the average level of the general government output indicator (GGO, % GDP), to see which are the most important producers of services and public goods, from 2009 to 2020: Denmark, Finland, Sweden, Croatia, Hungary, France.

Figure 3. The average level of the GGO indicator (average GGO, 2009-2020, % GDP) in EU member countries, by descending order



Source: Own compilation from Eurostat database.

Regarding the dynamic evolution of the general government output (GGO) indicator in the EU member states, from the table in Annex 1 results that, for the time period 2009 – 2020, the GGO dynamics has been increasing for 17 countries and decreasing for the other 10 member states. The bigger governmental producers recorded modest declines (Denmark 89.04%, Finland 99.6%, Sweden 98.17%) in contrast to Croatia (111.8%) and France (101.8%).

Romania recorded, in the analysed period 2009-2020, a significant upward dynamic (112.15%) of the GGO (% GDP), starting from the minimum value of 15.7% of the GDP in 2011 and 2014, up to a level of 19 % GDP in 2019 and 20.3% in 2020, and the average level of the GGO indicator in Romania was 17.1 (%GDP).

2.2. Taxes on production and imports (TPI, %GDP); issues and trends

Taxes on production and imports TPI (ESA code 2010 D.2) represents compulsory, unfair fees, levied by public administrations or European Union institutions, on the creation and import of products, the employment of workforce, ownership or use of land, buildings or other assets used in production. Such taxes are paid regardless of the profits made. Tax payments are called unrequited because the government or EU institution does not give anything directly in return for the payment (without compensation).

In the national accounts, taxes on products are a subheading within taxes/transaction taxes on production and imports. Product taxes are taxes paid per unit of a good or service produced or traded. Product taxes include value added tax VAT, import and export duties and taxes and other product taxes (e.g., excise duty, stamp duties on the sale of certain products such as alcoholic beverages or tobacco, vehicle registration taxes, on lotteries, taxes on insurance premiums).

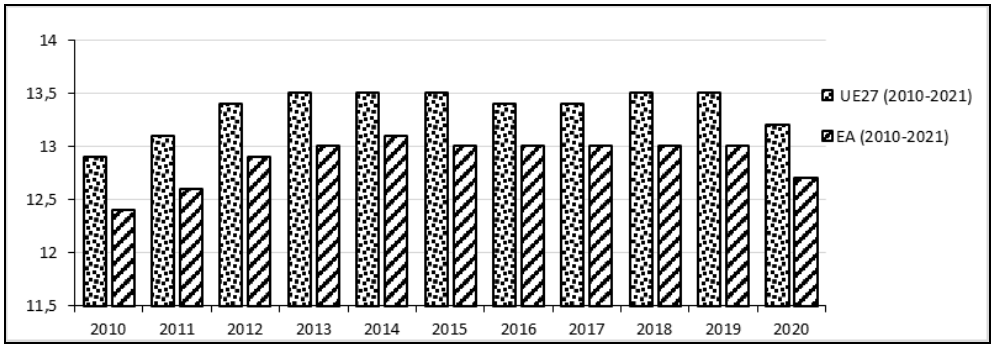
Table 3. Taxes on production and imports (TPI), in the EU and the Euro Area (% GDP)

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	*Average 2009-2020*
UE		12.9	13.1	13.4	13.5	13.5	13.5	13.4	13.4	13.5	13.5	13.2	*13.35*
EA		12.4	12.6	12.9	13.0	13.1	13	13	13	13	13	12.7	*12.88*
Dif.		0.5	0.5	0.5	0.5	0.4	0.5	0.4	0.4	0.5	0.5	0.5	*0.47*
Min. UE	8.1	9.9	9.6	10.2	10.8	10.7	8.6	8.7	8.3	7.9	7.7	6.5	*9.3*
Max. UE	22.4	22.0	21.6	21.9	21.8	21.5	21.5	22.4	22.3	22.3	21.9	21.7	*21.9*
Romania	10.2	11.9	13.1	13.2	12.7	12.7	13.3	11.3	10.3	10.4	10.6	10.4	*11.68*

Source: own compilation from Eurostat database, tec00020.

Regarding the evolution of the indicator Taxes on production and imports (TPI), as a % of GDP, during 2009-2020, Table 3 and Figure 4 show some small differences between the EU aggregates (27 states) and the Euro Area (EA, 19 states), as well as the EU minimum and maximum annual values of this indicator.

Figure 4. Taxes on production and imports, in the EU (UE27) and the Euro Area (TPI, % GDP)

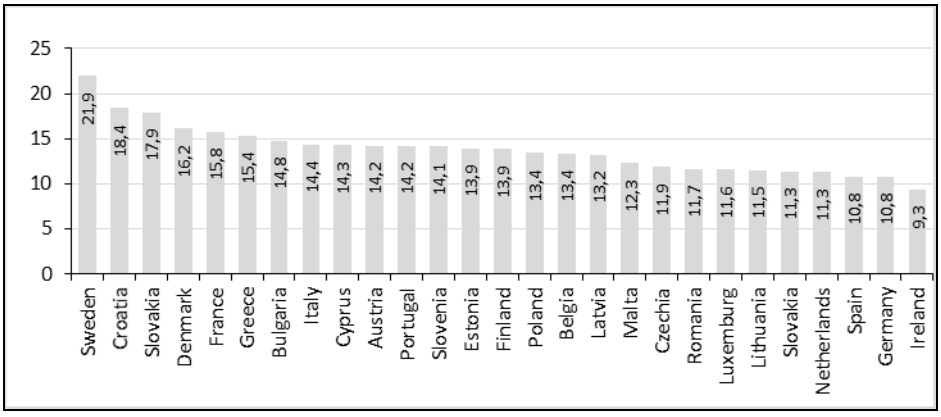


Source: own compilation from Eurostat database, tec00020.

It can be noticed that, from the point of view of its GDP percentage, during 2010 – 2020, the TPI had a slightly increasing trend, both at EU level and in EA, with an EU average annual level of 13.35% (GDP) and 12.88% (GDP) in EA, so in the Euro Area the level of this indicator was at least 0.4 (% GDP) lower each year. In 2020, this trend stopped and the indicator decreased slightly (by 0.3% GDP in the EU and EA) due to the Covid-19 pandemic and the quarantine period, with tax deferral or exemption measures.

From an annual evolution point of view, Table 3 shows the annual evolution of the lowest (EU Minimum) and the highest levels of TPI (% GDP) in all EU countries. The EU minimum varies between 6.5% (GDP) of Ireland (in 2020) up to 10.8% of Ireland (in 2013). The maximum value of this indicator was 22.4% (GDP) in Sweden, reached in 2009, but also in 2016.

***Figure 5. Taxes on production and imports – average (TPI m % GDP), by EU member* countries, in descending order**



Source: own compilation from Eurostat database, tec00020.

Figure 5 highlighted the EU countries in descending order of the average level of the indicator Taxes on production and imports (TPI m, % GDP), in order to observe which are the most important tax collectors, from 2009 to 2020: Sweden, Croatia, Slovakia, Denmark, France, and Greece.

In terms of dynamics, some large tax receivers generally recorded modest decreases (Sweden 96.88%, Denmark 98.16% and Austria 95.8%), unlike other states with high levels, which had increasing dynamics (Croatia 110.65%, France 113.42% and Greece 140.17%).

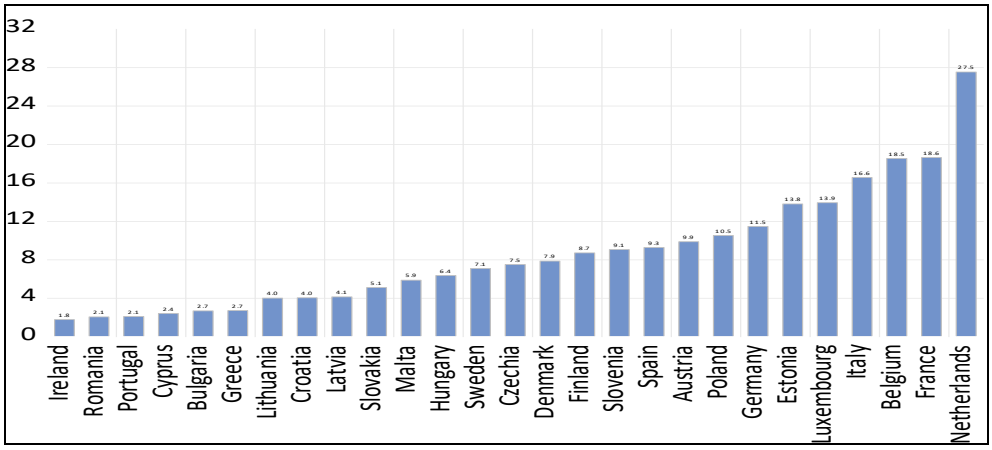
Romania stands among the countries with modest levels of this indicator (TPI, % GDP) and ranks between the last 8 EU states, in the 20th position in the EU. It recorded a stable or slightly upward trend (101.96%) of taxes on production and imports as % GDP during the analysed period.

2.3. Circular material use rate (CMUR) – synthetic indicator of CE

CMUR (unit of measure %) belongs to the set of CE indicators. Its purpose is to track CE progress of secondary raw materials use. CMUR highlights the amount of recycled materials replacing primary resources.

CMUR is calculated by estimating the waste recycled in local recycling plants minus waste imported for recovery plus waste exported for recovery abroad. More secondary materials are substituting for primary raw materials, resulting in a lower CMUR percent value, which lessens the environmental effect of raw material extraction. The Statistical Office of the European Union (Eurostat) is the data supplier, while the European Statistical System (ESS) is the data source.

Figure 6. CMUR average, by country, 2010 – 2020 (%)

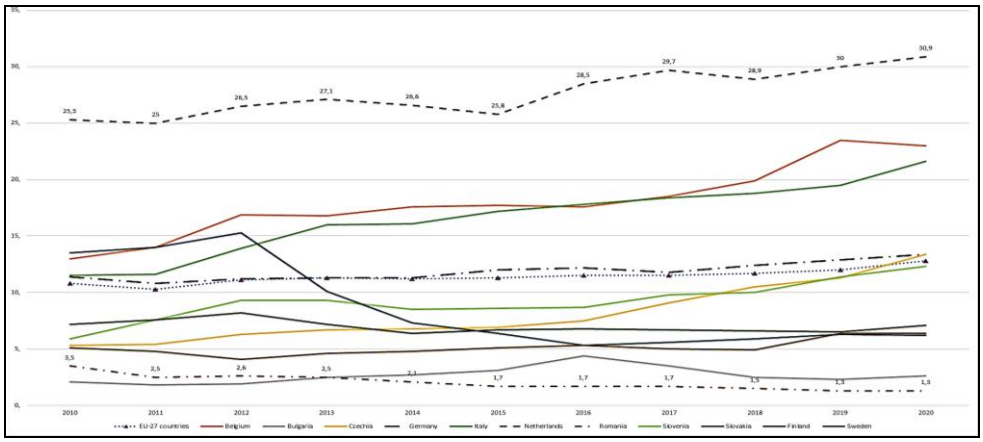


Source: own compilation from Eurostat database, 2022.

Figure 6 shows the CMUR indicator, by EU country, for the period 2010 – 2020 (average, in %). It can be seen that the most advanced country in the EU is the Netherlands, with a CMUR value of 27.5%. This means that, in the Netherlands, a very significant percentage of the raw materials used is made up of recyclable materials. France (18.6%) and Belgium (18.5%) are also advanced in the CE, still at a relatively large distance. The degree of circularity drops rather rapidly to a minimum value of 1.8% (Ireland). Romania and Portugal registered a low value of 2.1% and 1.8%.

In Figure 7, the evolutions of the CMUR indicator are graphically represented, for some member states and for the entire EU.

Figure 7. Evolution of CMUR (%), for some EU member states (2010 – 2020)



Source: own compilation from Eurostat database, 2022.

If the dynamics of the CMUR (2010 – 2020) are analysed, it can be seen that there was a slight increase at EU level, from 10.8% in 2010 to 12.8% in 2020 (18.5% increase).

The largest dynamics are mainly registered by the countries that started from low values of the indicator. For example, Latvia has a dynamic of 350% but the starting base is low value (1.2%). Similarly, Croatia has a dynamic of 318.8% but the starting base is 1.6%.

It can be noted that there is a group of countries that recorded reductions in the CMUR value: Luxembourg with a decrease of 43.6%, Romania with a decrease of 62.9%, Finland with a decrease of 54.1%. It is not very clear why they had these important reductions in the circularity rate.

It is possible that the change in the calculation methodology has an influence but this hypothesis is contradicted by the countries that have recorded constant increases in the indicator.

3. The influence of financial policies on the circular economy

To analyse the financial policies influence on CE, two indicators were chosen, which will be considered exogenous variables: General Government Output (GGO) and Taxes on Production and Imports (TPI). Both of them are expressed as a share of GDP (%).

Figure 8 shows the histograms of the two selected indicators. It can be observed that, in the case of GGO, the member states have a range of values between 11%-30%. Most countries are in the 18%-24% range. In the case of TPI, a range of values can be found between 7%-23%. Most Member States are in the 10%-20% range.

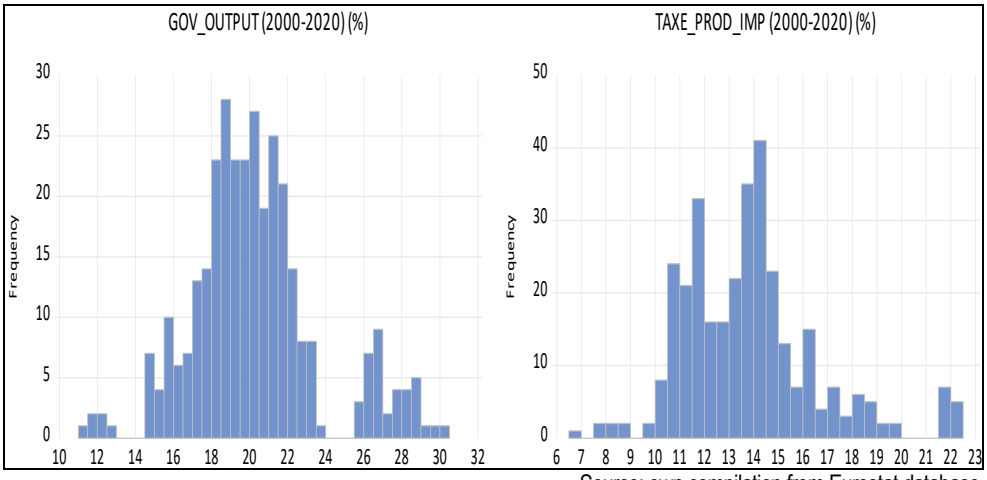
For the purpose of measuring the financial policies influence on CE, CMUR was considered a dependent variable and GGO (GOV_OUTPUT) and TPI (TAXE_PROD_IMP) as independent variables with a gap of one year (lag = – 1). Thus, the OLS regression model was used for a panel of 27 countries and a time interval of 11 years (2010 – 2020).

Equations 1 and 2 resulted. The parameters of the two models are recorded in Appendix 1 and Appendix 2, and the corresponding diagrams are those in Figures 9 and 10.

CIRCULAR_MAT_USE= 11.403675727 – 0.1406940214*GOV_OUTPUT (-1) Eq. 1
CIRCULAR_MAT_USE=10.85354054 – 0.1747775879*TAXE_PROD_IMP(-1) Eq. 2

The analysis of the coefficients in the two equations shows that they are statistically significant (p<0.0000). Both coefficients are negative and with low values. This means that, along with the increase of GGO and TPI, there is a slight decrease in the circularity of the analysed economies.

Figure 8. Government output and taxation, as a share of GDP, EU member states (2010-2020)

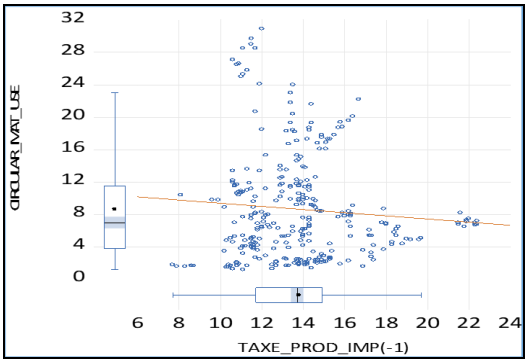


Source: own compilation from Eurostat database.

European economies that have the TPI indicator in the range of 8-12% of GDP register higher degrees of circularity than countries that have registered TPI values in the range of 14-22% of GDP.

The lowest circularity values correspond to countries with high taxes on production and imports (22%) (Figure 9).

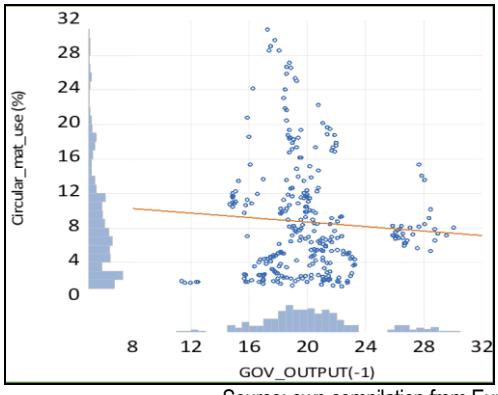
Figure 9. CMUR – TPI Relationship



Source: own compilation from Eurostat database, see Annex 2.

From the perspective of general government output, a similar situation can be identified. Most EU member countries have the GGO indicator in the range of 15%-23% of GDP (Figure 10). Only a few countries have the GGO level, around 28% of GDP. A similar phenomenon can be observed: circularity decreases with the increase in the level of general government output relative to GDP.

Figure 10. CMUR – GGO Relationship



Source: own compilation from Eurostat database, see Annex 3.

However, it is important to note that the two models have low values of R squared, which is a sign that the equations have low explanatory power and therefore the refinement of the two models is required.

Conclusions and recommendations

As analysed and grounded by literature review, the CE transition is based on three main pillars somewhat similar to the pillars of sustainable development: environmental benefits reinforce the ecologic pillar; cost savings strengthen the economic pillar of the circular economy; the creation of new markets, jobs or value, constitutes the social pillar of CE.

Economic and social development policies have the role of consolidating the pillars of the circular economy. The objective of the research in this paper was to highlight the role of public financial policy in promoting the transition to the circular economy.

Literature review demonstrated that the current tax system works for the linear economy paradigm, reinforcing its linear nature. Because of this, it is necessary to alter the current tax code in order to promote the circular economy business model.

The paper presented the relevant analysis indicators for the financial (fiscal-budgetary) policy of the EU states, from the perspective of the circular economy. A static and dynamic statistical-economic analysis was carried out for all EU member states, as well as the EU-27 and Euro Area aggregates, for the period 2009-2020 or 2010-2021, based on the data series extracted from the Eurostat database, regarding Government Finance Statistics).

The analyses led to the following conclusions:

Between 2009 and 2020, general government output GGO (% GDP) showed a slightly downward trend in both the EU and the EA, with an annual average of 19.22% (GDP) in the EU and 18.69% (GDP) in the Euro Area. It is established that in the Euro Area the level of the indicator was at least 0.5% (GDP) lower every year, 2009-2020. Regarding the evolution of the annual GGO indicator (% GDP) in the EU member states, during the period 2009-2020, the dynamics was increasing for 17 countries and decreasing for the remaining 10. Romania is in one of the last places in the EU (the 23rd) at the GGO average (17.10% GDP), but recorded an upward trend (112.15%) in the period 2009-2020.

In the period 2010-2020, the indicator Taxes on production and imports (TPI) had a slightly increasing trend, both at EU level and in the EA, with an average annual level in the EU of 13.35% (GDP) and 12.88% respectively %(GDP) in EA, so in the Eurozone the level of the indicator was at least 0.4 (% GDP) lower, every year. In 2020, this trend stopped and the indicator decreased slightly (by 0.3% GDP in the EU and EA) due to the Covid-19 pandemic and the quarantine period, which brought tax deferral or exemption measures.

Between 2010 and 2020, the dynamics of the TPI (% GDP) was increasing for 16 countries and decreasing or stable for the remaining 11 EU member states. Romania, which is among the countries with modest levels of the indicator (TPI, % GDP), respectively falls among the

last 8 EU states, in the 20th position in the EU, recorded a stable or slightly upward trend (101.96%).

Given that CE means to increase the recycled material amount, to reduce waste and to limit the resources extraction, the CMUR can be considered a synthetic indicator, measuring the share of CE in the national economy of an EU member state.

In the case of financial policies, the influence on the circular economy was analysed through the lens of two indicators: General Government Output (GGO) and Taxes on Production and Imports (TPI). Both indicators are expressed as a percentage of GDP (%). These indicators were used in the regression model as determinant variables for the CMUR circularity variable.

The two regression equations indicate the following reasoning: increases in taxation or government output, above a certain limit, lead to a reduction in the degree of circularity. It is more advisable that TPI and GGO are kept at relatively moderate values (16-20%) for the circular economy to develop. The increase of these indicators above 20% will lead to a decrease in the degree of circularity. These developments are likely in the absence of specific financial measures to encourage recycling.

Such analysis is important in the financial policy of each member state and can contribute to increasing the degree of circularity. As it stands in 2022, no fiscal measures have been identified to contribute to the faster growth of the circular economy.

The Romanian National Strategy regarding the Circular Economy adopted in the fall of 2022 outlines the main directions and areas of development in Romania, taking into account the fact that the state is still at an early stage of the transition process to the circular economy and that more efforts are needed to promote, allow and facilitate changes in all economic sectors. However, regarding the policies and financial instruments, they are to be grounded in the future National Action Plan for the Circular Economy expected to be adopted by the end of 2023.

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Annex 1. General government output in EU countries (GGO, %GDP), yearly average and dynamics, 2009-2020

No.	UE member state	GGO year average (% GDP)	Dynamics (%, 2020/2009)
1	Belgium	18.87	103.68
2	Bulgaria	17.36	103.89
3	Czech Republic	20.03	101.42
4	Denmark	27.88	89.04
5	Germany	15.13	111.92
6	Estonia	20.46	100.00
7	Ireland	15.09	59.50
8	Greece	21.54	98.70
9	Spain	19.33	106.03
10	France	21.67	101.82
11	Croatia	23.18	111.84
12	Italy	19.34	102.00
13	Cyprus	19.92	94.81
14	Latvia	21.11	100.00
15	Lithuania	18.00	85.98
16	Luxembourg	16.27	109.20
17	Hungary	21.86	104.44
18	Malta	20.56	107.37
19	Holland	18.33	95.83
20	Austria	20.38	100.47
21	Poland	18.84	99.48
22	Portugal	20.28	89.47

No.	UE member state	GGO year average (% GDP)	Dynamics (%, 2020/2009)
23	Romania	17.10	112.15
24	Slovenia	21.11	102.35
25	Slovakia	18.28	113.74
26	Finland	27.86	99.64
27	Sweden	26.3	98.17
	EA – Euro Area	18.69	101.55
	EU – European Union	19.22	101.0

Source: own compilation from Eurostat database.

Annex 2. CMUR – TPI Relationship parameters

Dependent Variable: CIRCULAR_MAT_USE				
Method: Panel EGLS (Cross-section weights)				
Sample (adjusted): 2010 2020				
Periods included: 11				
Cross-sections included: 27				
Total panel (balanced) observations: 297				
Linear estimation after one-step weighting matrix				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	10.85354	0.420678	25.80014	0.0000
TAXE_PROD_IMP(-1)	-0.174778	0.022392	-7.805310	0.0000
	Weighted Statistics			
Root MSE	6.381779	R-squared		0.171169
Mean dependent var	19.95085	Adjusted R-squared		0.168359
S.D. dependent var	23.76341	S.E. of regression		6.403375
Sum squared resid	12095.95	F-statistic		60.92286
Durbin-Watson stat	0.187484	Prob(F-statistic)		0.000000
	Unweighted Statistics			
R-squared	0.005610	Mean dependent var		8.662626
Sum squared resid	12218.21	Durbin-Watson stat		0.036134

Source: own compilations.

Annex 3. CMUR – GGO Relationship parameters

Dependent Variable: CIRCULAR_MAT_USE				
Method: Panel EGLS (Cross-section weights)				
Sample (adjusted): 2010 2020				
Periods included: 11				
Cross-sections included: 27				
Total panel (balanced) observations: 297				
Linear estimation after one-step weighting matrix				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	11.40368	0.702760	16.22698	0.0000
GOV_ OUTPUT (-1)	-0.140694	0.028759	-4.892147	0.0000
	Weighted Statistics			
Root MSE	6.401833	R-squared		0.075041
Mean dependent var	18.00034	Adjusted R-squared		0.071906
S.D. dependent var	18.29920	S.E. of regression		6.423497
Sum squared resid	12172.09	F-statistic		23.93310
Durbin-Watson stat	0.164634	Prob(F-statistic)		0.000002
	Unweighted Statistics			
R-squared	0.004345	Mean dependent var		8.662626
Sum squared resid	12233.74	Durbin-Watson stat		0.035540

Source: own compilations.

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